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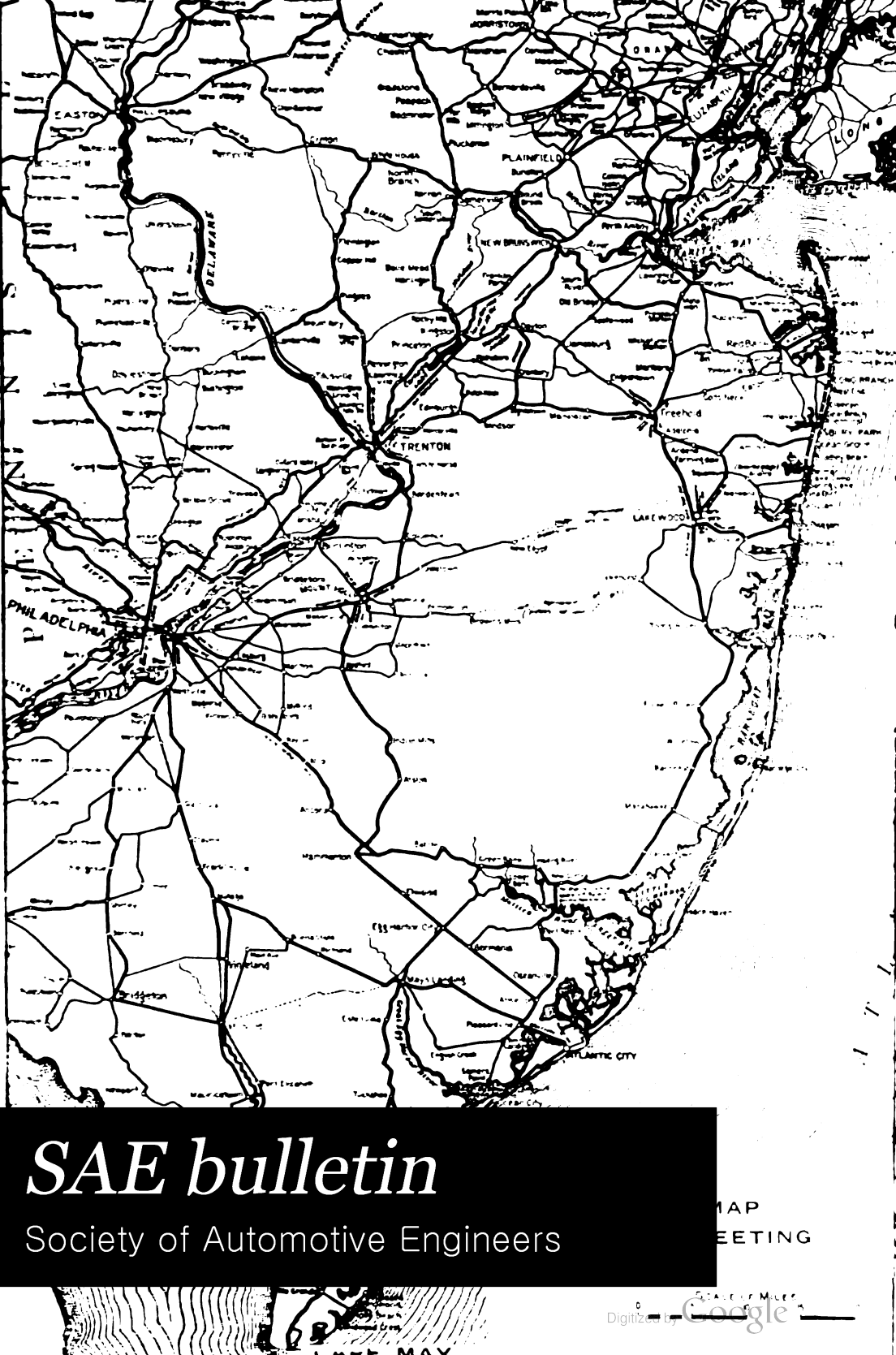

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S. A. E. BULLETIN

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S. A. E. Bulletin

VOL. VI APRIL, 1914 No. 1

Published monthly by the Society of Automobile Engineers
1790 Broadway, New York
HENRY M. LELAND, President. COKER F. CLARKSON, Secretary.
HERMANN F. CUNTZ, Treasurer.

Entered as second-class matter, April 9, 1912, at the post office at New York, New York, under the Act of July 16, 1894.

ON S. A. E. STANDARDS

It is quite possible that the saving from use of S. A. E. Standards is more than a dollar per car. We can buy cheaper screws, taps, dies, spark plugs and steels. In the case of ball bearings, etc., we can get better delivery.

David Fergusson—PIERCE-ARROW.

There is considerable saving in the use of standard parts, and naturally we prefer to use S. A. E. standards, as we consider them more adapted to the purpose than some of the others.

George W. Dunham—CHALMERS.

Lack of proper standards has cost the industry millions in the past—the work of the S. A. E. will save many more millions in the future—every first-rate industry in the world either has been or is being standardized.

Adherence to the standards of the Society has saved our own company thousands of dollars yearly in lowered material costs and in lessened production complications.

H. E. Coffin—HUDSON.

There is no doubt that S. A. E. standards result in considerable saving in labor and cost.

J. G. Perrin—LOZIER.

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S. A. E. standards are already saving us in drafting work on new designs. We are heartily in favor of the extension of standards along general lines, and will be glad to co-operate in the furtherance of the work.

W. R. Strickland—PEERLESS.

We certainly favor standardization along sound lines to a degree that will not hamper the individuality of the engineer. There is no use discussing this point, however, as I believe that practically the entire Society is agreed on this point.

J. G. Vincent—PACKARD.

We find a great saving in the time of the designing engineer, the drafting department and the purchasing department in using S. A. E. standards. The use of these standards reduces the cost on the number of parts which we buy and makes possible much better deliveries.

W. G. Wall—NATIONAL.

The recommended practices of the Society of Automobile Engineers have been of incalculable benefit to the automobile industry at large.

A. L. Riker—LOCOMOBILE.

S. A. E. standards reduce or simplify labor. The saving in money to my company could undoubtedly be estimated.

H. B. Anderson—WINTON.

The saving in the factory is considerable, the work in the engineering department is safer, more rapid and less tedious.

C. S. Crawford—COLE.

We use S. A. E. standards in many cases and favor more standards.

E. A. DeWaters—BUICK.

We are in full sympathy with the work of the Standards Committee and believe it to be very valuable.

M. S. Young—REGAL.

We use S. A. E. standards, which have reduced or simplified labor very much. We favor more standards on such parts as are not susceptible to improvement in design.

W. E. Holland—ANDERSON ELECTRIC.

We use S. A. E. standards on all materials—the same reduce or simplify labor greatly.

R. S. Fend—WOODS ELECTRIC.

The standards so far adopted have helped us in our purchasing and assembling, and we favor more standards.

W. C. Fisher—RAUCH & LANG.

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Quite a substantial amount is saved by the use of S. A. E. standards.

R. P. Lay—FRANKLIN.

I believe that the efforts of S. A. E. along standardization lines have been extremely useful to the motor car industry in general.

H. D. Church—PACKARD.

S. A. E. standards have undoubtedly been of the greatest assistance. I favor more standards wherever the interests of producer and consumer can be harmonized to benefit the majority.

B. B. Bachman—AUTOCAR.

S. A. E. standard truck wheels save us carrying about $1,500 of special wheels, tires and rims in stock.

W. T. Norton, Jr.—SELDEN.

We use S. A. E. standards very largely, and their use, which is extending, has reduced or simplified labor. The saving must unquestionably be large in many cases. The value of standardization must be accepted as a principle, as it is usually difficult to show saving in dollars and cents.

H. L. Barton—GENERAL MOTORS.

We use S. A. E. standards, which without doubt reduce or simplify labor.

A. C. Bergmann—MERCER.

We have noticed with interest the excellent standards work which has been done, and believe the industry has been benefited immensely. In all cases in which the future work of the Society may affect the product or activity of this company you may count upon our hearty co-operation.

W. H. Palmer, Jr.—ELECTRIC STORAGE BATTERY CO.

So far as I am acquainted with the S. A. E. standards, they have been adopted with due reference to engineering outside of the automobile field.

A. H. Moore, Chairman Standardization Committee,
GENERAL ELECTRIC COMPANY.

We conform wherever possible to S. A. E. standards, the use of which simplifies the automobile equipment branch of our business. We believe there is considerable field for additional standardization.

H. P. Davis, V. P.—WESTINGHOUSE.

Our saving since the adoption of S. A. E. standards is roughly a few thousand dollars.

A. D. T. Libby—SPLITDORF.

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We have found in the short time the writer and some of his men have been members of the S. A. E., a fund of valuable information in its publications.

G. Brewer Griffin, Manager Detail and Supply Department,
WESTINGHOUSE.

S. A. E. standards reduce or simplify labor in designing and purchasing of stock particularly.

A. E. Berdon—ESTERLINE.

S. A. E. standards reduce and simplify labor in many departments—the money saving can be estimated.

Geo. A. Scoville—DEAN ELECTRIC.

The Society is certainly far ahead of the older and more conservative engineering societies. The value of standardization it is impossible to overestimate.

V. M. Palmer, Purchasing Engineer.

We find S. A. E. standards a great convenience as well as saving in many different ways.

T. M. Custer—A. O. SMITH.

We use S. A. E. standards. They reduce and simplify labor to a marked degree.

C. A. Broesel—SIMPLEX.

The reduction in labor and facility with which materials can be secured have saved thousands of dollars annually to our company.

C. B. Whittelsey—HARTFORD RUBBER WORKS.

S. A. E. standards have reduced or simplified labor, much smaller stock and fewer sizes being needed for solid tire wheels, fewer jigs and tools. A great deal less money is invested in stock and there is a great saving in tools at rolling mills and rim plants.

E. R. Hall—GOODYEAR.

The work of the Society has undoubtedly profited the trade in general to a great extent.

H. H. Hoffstaedter—POLACK.

We have been benefited by the use of S. A. E. standards in connection with the aluminum alloys.

W. P. King—ALUMINUM CASTINGS CO.

The information embodied in the report of the S. A. E. Sheet Metals Division should be of great service to the users of our product.

Robert Skemp—AMERICAN SHEET AND TIN PLATE.

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There is no doubt but what some metals which are being used have been reduced in price by the makers, due to the fact that the standards as adopted by the S. A. E. have thrown a great many specifications which were nearly identical into one group, thereby enabling the maker to develop a business of some magnitude in some one composition, where before he was trying to satisfy everybody and not getting anywhere. We believe that a great deal of good has been accomplished, but that the specifications as they stand are too multitudinous and unnecessarily so.

George F. Fuller—WYMAN & GORDON CO.

The benefit that we directly see is the avoidance of the necessity of producing steels to specifications which, while they match each other in efficiency, so nearly approach each other without exactly coinciding, that it seemed impossible for the steel producer to come anywhere near the position of being able to carry any materials in stock to supply the requirements of the automobile trade. This situation has been much improved since the first issuance of the specifications.

W. P. Barba—MIDVALE STEEL CO.

Several grades of steel have been popularized by S. A. E. specifications. High-priced branded steel is less used; probably saving millions of dollars; and the S. A. E. has been and is an important factor.

Henry Souther—FERRO.

Steels to S. A. E. standards can be bought at probably 15 per cent. lower prices than before the specifications were adopted.

E. L. French—CRUCIBLE STEEL.

Steels, especially those of alloy compositions, are cheaper today than they were five or three years ago. I believe the S. A. E. is responsible for this in that it has thrown much light on the subject of alloy steels, which has resulted in much wider use and correspondingly decreased the cost by reason of greater volume.

F. W. Trabold—J. H. WILLIAMS & CO.

The efforts of the S. A. E. have cut down prices on tools, jigs, etc., in a marked degree.

Arthur M. Laycock—SHELDON AXLE CO.

S. A. E. standards and the data in the S. A. E. book have proven so valuable to us from an engineering view that we do not see how their place could be occupied by any other set of data now extant. We have been able to purchase S. A. E. standard material on the open market where otherwise it would have been a special proposition. There are innumerable details working into automobile design capable of standardization.

F. G. Hughes—NEW DEPARTURE.

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It will be better for all parties concerned to adopt something that is regular. We will hold wherever possible to the S. A. E. standard 1½" taper, but it looks as though it could not be absolutely standard.

H. W. Chapin—BROWN-LIPE.

It goes without saying that in some establishments the effect of standardization would be more than in others, but taken as a whole, I think it would average at least 20 per cent. (Broaches Division Practice.)

F. L. Eberhardt—GOULD & EBERHARDT.

Our company has decided to adopt on all new work and throw its influence in favor of S. A. E. standard taper finish, including dimensions of thread and key. There is no reason in the world for having different size threads. I believe the adoption of these standards will be of direct assistance all around.

H. W. Alden—TIMKEN-DETROIT.

We shall certainly co-operate in adhering to S. A. E. standards for both squares and tapers, just as far as our customers will permit.

S. O. White—WARNER GEAR.

All Rayfield carbureter flanges conform to S. A. E. standard. S. A. E. standards have saved us a great deal of money in patterns, tools and jigs.

C. W. Findeisen—FINDEISEN & KROPF.

We manufacture the S. A. E. flared tube unions and union fittings and find the call for same is gradually increasing.

J. J. Aull—LUNKENHEIMER COMPANY.

All 1914 Stromberg carbureters of any model will be strictly in accordance with the S. A. E. practice and any deviation from this will be special.

C. W. Stiger—STROMBERG.

We will make it our business to recommend and advocate wherever possible and use ourselves, at all times, S. A. E. standards.

A. R. MOSLER.

All Holley 1914 carbureters will be equipped with standard S. A. E. flanges and other parts and any deviation from this will be considered special. In the past years oftentimes it has taken a day to put a new carbureter on, whereas now it is a matter of less than an hour.

G. M. Holley—HOLLEY BROS. CO.

We believe that the S. A. E. flange will be adopted as standard. We trust that the manufacturers will soon come to the point of asking for S. A. E. standard on the fittings. This will simplify matters very greatly.

George T. Briggs—WHEELER AND SCHEBLER.

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The cost to the consumer of standard gages is not one-third what it was under the old system where we were compelled to make gages specially to meet customers' requirements. We make a great many gages and taps and dies to S. A. E. standard. Since its adoption we have been able to manufacture these parts in large quantities, consequently selling them to the trade at considerably less than special gages which we were formerly called upon to make. We know of no movement amongst automobile manufacturers which is proving of greater value or is more to be recommended than the efforts to standardize wherever possible.

Joel W. Johnson—PRATT AND WHITNEY.

There have been a few instances of technical societies in this country issuing handbooks or manuals. One example is the Society of Automobile Engineers which has compiled a handbook of technical data of special value in the design of automobiles and their accessories.

Harold Pender, Chairman Handbook Sub-Committee,
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

There is no question that the establishment and adoption of the S. A. E. standard yoke and rod ends are a decided advance and progress in the way of economy. The S. A. E. standards are proving popular and to-day by far the greater part of our production in this line is S. A. E. As soon as we can discontinue the manufacture and carrying stock of the other lines, we will begin to appreciate a saving which should be estimated at at least 10 per cent.

F. C. Billings—BILLINGS AND SPENCER.

Our yearly saving due to the work of the S. A. E. Standards Committee, from our best estimates, is in the neighborhood of $5,000, based on a yearly output of $1,000,000. We believe this saving will increase from time to time as standardization becomes more universal.

Christian Girl—PERFECTION SPRING CO.

The adoption of the lock washer standards by the S. A. E. has effected many economies in the making of steel. In our own case we save probably one thousand dollars per year, but we are only one of half a dozen steel manufacturers making this steel.

H. A. Bugie—HELLER BROS. CO.

Of the last 24 million lock washers furnished the automobile trade, 67 per cent. were S. A. E. standard and fairly present the conditions in that line of trade as far as our orders are concerned.

J. E. Wilson—NATIONAL LOCK WASHER.

The sale of S. A. E. screws and nuts to both manufacturers and dealers has increased steadily and rapidly since the revision of the A. L. A. M. standard by the S. A. E.

E. H. Ehrman—CHICAGO SCREW CO.

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The S. A. E. truck wheel standards have simplified design, increased production, decreased the number of stock sizes carried, reduced cost and simplified accounting and repairs.

C. B. Hayes—HAYES WHEEL CO.

The standardization of felloe dimensions permits of saving in time and labor and insures better complete wheel assembly. Facilities for production are much improved.

L. S. Bowers—SCHWARZ WHEEL CO.

In my judgment the S. A. E. standard has saved about 8 per cent. on the selling price of truck wheels over the various standards in existence before that time.

Russell Hoopes—HOOPES BROS. & DARLINGTON.

Great benefit has been derived in motor truck tire steel equipment, as it allows not only the wheel-maker to reduce and simplify labor, purchasing an amount of stock to be carried, but also in the case of the motor truck manufacturer.

H. F. Harper—PRUDDEN & CO.

The S. A. E. standards encouraged truck wheel manufacturers to equip with new machines which can now be used effectively to produce more and also more nearly perfect work. Before the adoption of the standards each wheel had to be made to fit each individual band and for each make of tire a different width was required. Only few manufacturers were prepared to furnish large sizes; consequently there was little competition. These conditions have been changed; a number of wheel manufacturers are now equipped and competition compels them to pay close attention to the cost of production, competing with one another in price as well as quality. Most wheels are now not only cheaper but also of far superior quality. I consider that at least 20 per cent. of the reduction of price of commercial wheels is primarily due to the adoption of the S. A. E. standards.

CHAS. L. SCHWARZ.

We use S. A. E. standards and are convinced that they have resulted in a saving, but we cannot make a definite estimate of the amount. We believe that further standards along certain lines will result in economy both to manufacturer and user.

E. R. Whitney—COMMERCIAL TRUCK CO. OF AMERICA.

To a consulting engineer and designer the value of the S. A. E. standards is very great, although I am unable to estimate any actual financial saving myself. I certainly favor the extension of these standards in every possible direction.

A. J. Slade—CONSULTING ENGINEER.

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I am heartily in favor of standards and appreciate the excellent work already done by our Society.

A. P. Brush—CONSULTING ENGINEER.

I always use S. A. E. standards which, without doubt, reduce or simplify labor. The saving in money is very difficult to even estimate, but is large. More standards on electric starting and lighting apparatus are badly needed.

E. T. Birdsall—CONSULTING ENGINEER.

The saving could be estimated in the drafting department principally. There is an additional saving when purchasing goods, with the additional assurance that if goods come in accordance with the S. A. E. standards, they will be O. K. From the drafting standpoint in connection with designs of engines and chassis, in about $10,000 of drafting, about $500 worth of time would be saved.

Jos. A. Anglada—CONSULTING ENGINEER.

There has been much saving to the automobile manufacturer, manufacturers of screws and bolts and also tap manufacturers as a result of standardizing bolts and screws. At the present time practically all of the automobile manufacturers have adopted S. A. E. standard. We carry a stock of screw cutting tools on hand covering the full range of the S. A. E. standard and are enabled, because of the large consumption, to manufacture these in large quantities and consequently sell them at better prices than heretofore.

F. G. Eaches, Manager Small Tool Department,
PRATT AND WHITNEY.

The S. A. E. is in some ways a unique organization, but it is not merely an organization—it is a working agency of high efficiency. Every day the work of this Society leaves its mark on the American automobile industry. The problems that this body has had to solve were much the same problems, diverse and complex, that faced the railroads and their allied industries in their days of rapid growth. The automobile business brought with it almost innumerable engineering, manufacturing and industrial questions that demanded and still demand quick and skilful consideration.

MACHINERY, April, 1914.

Representatives of the Institution have been appointed to attend the meetings of the British Engineering Standards Committee, and the first of these meetings has taken place, and it is hoped that some good work will be done by our own sub-committee with

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standardization, as we are anxious not to fall behind the American society, who have already done a great deal in carrying out this most important and useful work.

Presidential address of T. B. Browne, INSTITUTION OF AUTOMOBILE ENGINEERS, of England, October, 1912.

The (British) Engineering Standards Committee has now seriously taken up the question of standardization of various parts of the automobile. Nine sub-committees have been definitely elected on which are representatives of the Institution of Automobile Engineers and the Society of Motor Manufacturers and Traders and other bodies interested.

AUTOCAR, March 21, 1914.

COMPARATIVE PRICES OF S. A. E. STANDARD AND NON-STANDARD PARTS.

With a view to ascertaining in a general way the difference in price of S. A. E. standard and non-standard parts, a member of the Society secured recently comparative prices on rod and yoke ends and lock washers.

As showing the advantage of using standard forgings machined to standard dimensions, it was stated to be quite true that the user of small quantities pays an excessive price for either special forgings or standard forgings machined specially.

As showing the relative additional cost on special work, quotations were made on two parts as follows:

1,000 Number X Standard at $10.80 C, machined.
1,000 Number X Special at $12.80 C, machined
Plus cost of forging dies, $40, and tools, $7.50.
10,000 Number X Standard at $9.75 C, machined.
10,000 Number X Special at $11.75 C, machined
Plus cost of forging dies, $40, and tools, $7.50.
1,000 Number Y Standard at $8.90 C, machined.
1,000 Number Y Special at $9.30 C, machined
Plus cost of forging dies, $38, and tools, $7.50.
10,000 Number Y Standard at $7.75 C, machined.
10,000 Number Y Special at $8.25 C, machined
Plus cost of forging dies, $38, and tools, $7.50.

On quantity of 25,000 special forgings the die and tool cost would be eliminated and the special forgings produced at approximately the same price as the standard.

On heavy and light lock washers prices were procured in comparison with prices on three different special lock washers having the same relative diameter, but the other dimensions varied. The lock washers upon which prices were secured were for use with bolts of a diameter ranging from 3/16 inch to ¾

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inch. On eighteen of these special washers the prices quoted were from 4 per cent. to over 100 per cent. higher than on those of S. A. E. standard, while on only five the prices were from 2 per cent. to 21 per cent. lower. In these latter cases, however, the washers were of smaller stock than those of S. A. E. standard.

In the back of this Bulletin there appears a blank which manufacturers who are producing articles in conformity with S. A. E. standards and recommended practices are requested to fill out and send to the S. A. E. office. Frequent inquiries are received as to where such articles can be secured and it is the desire to have the file record in the Society office as to sources of supply as complete as possible. A prominent automobile engineer stated recently that more parts made in accordance with S. A. E. standards would be used by his company if more reliable sources of supply were available.

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STANDARDS COMMITTEE MEETING

Held at the Society Rooms, New York, April 7, 8 and 9, 1914

STEEL SPECIFICATIONS

The meeting was called to order by Chairman Souther.

CHAIRMAN SOUTHER:—Some definite progress has been made by the Iron and Steel division. Mr. Zimmerschied will present its report.

K. W. ZIMMERSCHIED:—The report is practically to the effect that the Iron and Steel Division recommends the continuance of forty-two steels. At the meeting of the Division held before the meeting today the committee went through the list of steels which had grown too large entirely. A great many not exactly duplicates but overlaps, and also a lot used in small quantity we eliminated, getting the specifications down to a practical basis and including all the steels anybody can ever have any need for.

The next important action was the drawing up of forms for the collection of additional and more concordant data on the physical properties of these steels when heat treated according to the S. A. E. recommended practice. We hope that before the June meeting of the Society we will have collected at least enough data to get two or three or possibly more steels presented in good concordant form. We are going to make an effort to give a little better list of properties this summer than we did last summer.

Running through the specific recommendations, the first is to omit the dash from the specification numbers—that is, instead of 10—10, to use 1010, because the dash has resulted in confusion in the minds of a good many people who were used to specifying .10—.20 carbon, for example. The last two, in some cases three, figures of the specification numbers indicate the carbon content as heretofore.

In the carbon steels we eliminated four grades and substituted three grades for those four, which represents a little better lineup with commercial practice. The phosphorus and sulphur limit we raised in line with ordinary commercial practice at the present time, to .045 and .05 per cent., respectively, except in the case of steel 1095. Manganese in one case, that is, the case-hardening grade, was lowered from .80 to .60 maximum,

Three nickel steels were eliminated. The maximum sulphur content we allowed to go to .045 in that grade.

In nickel chromium steels thirteen were eliminated and three new ones put in. These three represent a late development in the business, which is gaining strong enough foothold to earn recognition from the S. A. E.

The chromium low limit in steels 3120 and 3125, 3030, 3135 and 3140 was raised to .45. It used to be .30 to .75. The series low in chromium content, from .15 to .45, we left out. A footnote will be given to indicate that that grade is available, although not appearing among the specifications.

The nickel chromium vanadium steels are wiped out entirely, as there does not seem to be any use for them.

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In the chromium steels three new specifications were inserted.

One chromium vanadium steel was stricken out—making the total given before of forty-two steels recommended for retention, and forty-one of those formerly recommended and accepted, for elimination from our specifications.

CHAIRMAN SOUTHER:—You have heard the report of the work of the Iron and Steel Division. You may wonder why we have gone further into the subject. There has been an urgent request from the membership every time we have reported to the Society for some clear statement as to the physical characteristics of steels in connection with which the chemical characteristics have been given. In taking that up we naturally fell into the discussion of the number of steels necessary to be specified. There is an enormous number and we began to scan them, and in the light of the last few years' experience discovered that many of them are what might be called commercially obsolete; always obtainable, but not worth setting up as recommended practice.

The physical specifications involved a considerable discussion. Through the efforts of Mr. Zimmerschied forms for the collection of data, which seem excellent, have been prepared. They seem to solve the problem in a way that I feared it would never be solved.

SILICO-MANGANESE SPRING STEEL

W. M. NEWKIRK:—I notice one specification given for silico-manganese steel, the last one, 9250. Silicon is given there as 1.50 to 2.00, whereas, as I understand, the desired silicon is 2.00 rather than 1.75. Two per cent. is the analysis we try to get.

H. J. STAGG, JR:—I think the point a good one, Mr. Chairman.

K. W. ZIMMERSCHIED:—Two types of steel are being offered. One manufacturer adheres pretty closely to the specifications that we have there; another stipulates 2 to 2½ per cent. silicon, about the same carbon.

W. M. NEWKIRK:—I was not sure whether this specification was intended for leaf springs or some other class of work. But it being the only silico-manganese steel specification given in the report I made that point.

CHAIRMAN SOUTHER:—The specification was discussed, Mr. Newkirk, at considerable length with the steel-makers. Some of the consumers present felt that it covered the large volume. If we are wrong, we want to know. Is anybody else here purchasing silico-manganese steel for motor car springs?

THOMAS J. FAY:—We are running about 1.60 on the silicon, holding a good deal closer than fifty points. We reject usually anything as low as that is. That looks like something that the steel men would like to have us standardize.

CHAIRMAN SOUTHER:—The limits there are what, Mr. Fay?

THOMAS J. FAY:—Fifty points.

CHAIRMAN SOUTHER:—That is what?

THOMAS J. FAY:—1.50 to 2.00. You can drive a twenty-mule team through that.

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K. W. ZIMMERSCHIED:—I think this brings up a question which you find in a lot of these specifications. The limits are wider than any one purchaser of steel will ask for. We have tried to cover a lot of classes in the entire specification, rather than limit the specification to fifteen or twenty points to each separate scale.

THOMAS J. FAY:—There is one thing that with these specifications it is easier to do, that is, to put a high price on a low standard. If a steel man can say it is an S. A. E. standard, that establishes the quality, and he will put on a high price; because goods of the quality of specifications always cost more than the run of the mill.

W. M. NEWKIRK:—I would not put it quite as broadly as that, although, as Mr. Fay says, if you wanted to get something with a little closer limit, the steel man would say "That is not standard and we will have to charge you for that."

CHAIRMAN SOUTHER:—Well, that has come up a great many times in discussion. We find by experience that one concern will specify five points, and another ten points either side. It seems to be whatever they can get along with or at least what they think they can get along with. It would be very interesting to hear, I am sure, from one of the silico-manganese steel manufacturers what limits of silicon are reasonable from a manufacturing standpoint. I think that question has not come up.

H. J. STAGG, JR.:—We can hold our product within ten points plus or minus in silicon.

CHAIRMAN SOUTHER:—In the neighborhood of 1.75, for example?

H. J. STAGG, JR.:—Or 2. Our practice is 2.

J. H. PARKER:—Two per cent. is probably nearer right for silicon than 1.75.

CHAIRMAN SOUTHER:—How close would you care to work commercially?

J. H. PARKER:—We ought to have twenty points plus or minus.

CHAIRMAN SOUTHER:—That is forty, total?

J. H. PARKER:—Yes, on a two per cent. silicon.

C. F. W. RYS:—We do not manufacture this high silicon-manganese steel. Of course, the range depends altogether on the process by which it is manufactured. I would say that if you manufacture more than ten tons in one heat, a range of twenty points is not too much.

W. M. NEWKIRK:—So far as I know the steel that we have used has always been to a closer limit than twenty points plus or minus silicon. I am not quite prepared to say what it would be if we got outside of it. I would be a little afraid of it.

J. G. UTZ:—I would rather see less than forty for the limit. I would rather stay down to the low figure, under 1.75. I think these specifications are intended to give a general idea rather than to cover any specific case. Manufacturers as a rule do not find it hard to meet special cases when it is desired.

K. W. ZIMMERSCHIED:—Suppose we do make a specification of 2 to 2.20 or 1.90 to 2.20. Then Mr. Utz will come along and want 1.60 to 1.90

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and the steel-maker would say "That is not a standard steel and we will have to charge you extra for it."

J. G. UTZ:—I take it that this steel is meant for a spring steel?

K. W. ZIMMERSCHIED:—Yes.

W. M. NEWKIRK:—If you have to stop and specify in each case just what you want, the fact that a specification may be recommended as a standard does not help much.

THOMAS J. FAY:—We reject above .60 manganese and above 1.75 silicon. Now particularly with these high metalloids—as a matter of fact, our metalloids are not nearly half the amount specified here—I go back to my original statement. I do not see any use of specifying steel so loosely as that. It would simply induce a high mark without an adequate return on the specification. They will say it is a specification steel and charge for it, whereas, as a matter of fact, it is not a specification steel. It is a perfectly loosely drawn specification, which does not amount to anything, which would have to be revised before you could specify anything. No man living on the production side would dare use steel within this specification, would even think of it.

CHAIRMAN SOUTHER:—Are there any further remarks?

K. W. ZIMMERSCHIED:—It seems to me that we will have to have two specifications in this class of steel. What one man says he would not use under any conditions, another man wants.

THOMAS J. FAY:—If there are two steels, I think that it would be proper to specify them. Surely you do not expect to split between them and specify neither one.

CHAIRMAN SOUTHER:—That attempt has not been made. We tried to find out the large volume, and it seemed to come within the limits specified.

THOMAS J. FAY:—I think that cannot be shown.

CHAIRMAN SOUTHER:—I would not undertake to say. We have only the statements of consumers and producers present to judge from. If there is a desire for two grades of silicon-manganese spring steel, or three, there is no reason why they should not be specified, the same as for nickel chromium or some other quality.

J. G. UTZ:—We could not afford to buy steel within that specification and use it, and we probably produce a greater tonnage of silico-manganese steel springs than anybody else in the country.

CHAIRMAN SOUTHER:—How would you write a specification for spring steel?

J. G. UTZ:—I would say that the limits of carbon are not too wide. I would rather see the carbon from .50 to .60.

CHAIRMAN SOUTHER:—Rather than .45 to .55?

J. G. UTZ:—Yes.

CHAIRMAN SOUTHER:—And silicon?

J. G. UTZ:—1.55 to 1.75.

CHAIRMAN SOUTHER:—Manganese?

J. G. UTZ:—.55 to .65.

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CHAIRMAN SOUTHER:—Phosphorus?

J. G. UTZ:—Both sulphur and phosphorus ought to be .03 or better.

W. M. NEWKIRK:—I would say from 1.90 to 2.10 per cent. silicon.

CHAIRMAN SOUTHER:—And Carbon?

W. M. NEWKIRK:—.45 to .55.

CHAIRMAN SOUTHER:—Manganese?

W. M. NEWKIRK:—.65 to .80.

CHAIRMAN SOUTHER:—Phosphorus and sulphur?

W. M. NEWKIRK:—.04.

K. W. ZIMMERSCHIED:—I submit that if the first specification of from .55 to .65 manganese were accepted by the Society and a user ordered steel according to that analysis from the steel manufacturers of this country making steel by the open hearth process, they would refuse to furnish it at any price. .55 to .65 manganese is only ten points, and would lead to the same thing that we have tried to get away from in our other specifications, endless correspondence and haggling over the different specifications. The same thing is true of the phosphorus and sulphur.

J. G. UTZ:—That same thing would be true of ordinary steels, but spring steels are limited. You cannot go over the limited range with spring steels. You have a definite work to do and treatment to get or it is useless.

THOMAS J. FAY:—Mr. Chairman, these buyers in this work pay for what is called specialty fabrics, a price always at a premium as compared with other products. Now unless we are going to get something for our money we had better not specify anything. If we are only going to get run of the mill, no very definite limit, in specialty contracts, there is no use specifying. The minute you put a specification on a thing they are going to put you on a specialty list, and the minute they put you on a specialty list they are going to charge more money. I can buy railway steel for less money than I can buy the products of automobile steel makers. Why? Because we are on the specialty list. Now what are we getting for our money? It seems to me it is utterly a matter of no moment whether or not nine-tenths of the mills will give us close limits of sulphur and phosphorus. We do not want the products of nine-tenths of the mills. We want the product of mills that will turn out what we want, and as a matter of fact we go to them and get it. There is no objection, as far as I can see, in using two standards, if you like. There may be people who would like to use cheaper steels, but I submit that the cheaper steel specification should not be fastened on to the specialty mills, because their price is fixed first and the product afterwards.

CHAIRMAN SOUTHER:—Then there is no difficulty, I imagine, in obtaining .55 to .65 manganese, as Mr. Zimmerschied suggests, at a commercial price?

THOMAS J. FAY:—We have probably one hundred tons of it on the floor at this minute.

CHAIRMAN SOUTHER:—Not varying ten points between maximum and minimum?

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THOMAS J. FAY:—That is approximately true.

CHAIRMAN SOUTHER:—Well, that is very encouraging indeed.

K. W. ZIMMERSCHIED:—I do not know whether that represents the kind of product we have been trying to make the basis of our specifications. I think we have borne down to get an open market proposition for every specification. I submit that that specification is not an open market specification. You have to go to a special mill to get it.

W. M. NEWKIRK:—My experience is the same as Mr. Fay's; you cannot get the product here and there and everywhere.

THOMAS J. FAY:—It seems to me that the specifications thus far have led to an open market, so far as they are concerned, but that the price of steel has been abnormally high, because you do put a specification on the low grades. They charge us the price of the specification steel but you do not specify it. In the meantime we have gone to the specialty mill for our product and had to ignore the specification, because it did not specify what we want; and we did not have to pay any more for what we did specify than if we went to the specialty mill for this.

If you will take the same idea into the structural department, you will find that the specification structural steel is higher-priced than the other kind. Why? Because it is a specialty in a sense. You cannot blame the steel mills for taking advantage of your invitation to charge more money. I do not see any apparent objection to having a second line of specifications of inferior steels. Somebody might like to use them. But I think that the S. A. E. ought not to specify inferior steels, with no advantage to any consumer, with the opportunity on the part of the steel mills to charge more.

CHAIRMAN SOUTHER:—Do any of the producers want to talk on that subject?

K. W. ZIMMERSCHIED:—According to that argument I do not see any use of our writing specifications for any steel. Putting into effect that argument would be a limitation of all the work this committee has ever done. We have always gone on the theory that if we could ever get specifications which would be agreeable to a great many people, make them widely accepted among the users and manufacturers, we would be doing a work which would lower the price of those steels. I hope we have not been wasting all this time.

CHAIRMAN SOUTHER:—We have before us now a definite silico-manganese steel. We have put upon the books one specification only to indicate that class of steel. I believe it is safe to say from discussion in this committee that this was an indication and that probably one school would choose from the lower limit of silicon and manganese and the other from the higher; and that the impurities were sufficiently regulated to produce excellent springs. However, if we are wrong about that, if we are mistaken, the change must be made. I think the proper thing to do is to refer the subject back to committee for further discussion, with the possibility of adding other grades of silico-manganese steel.

Of course, talking on the point of purity alone, there is no question that some want greater purities than others. There may be users of any

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of our steels who want below .02 sulphur. I do not know. Or .02 phosphorus. What we have given is not intended for the highly specialized user. If we specified for him, there would be one man applying steel under these specifications instead of a hundred, because the price would be prohibitory. The specifications as they stand in this case were drawn with that in view, as being for a commercial article, usually obtainable in the market without any special price whatever.

K. W. ZIMMERSCHIED:—Mr. Chairman, I move that the specification of silico-manganese steel be stricken from this report and referred back to the committee for further consideration.

(The motion was seconded.)

CHAIRMAN SOUTHER:—Any further remarks?

(The motion was put to a vote and carried.)

PHOSPHORUS AND SULPHUR

CHAIRMAN SOUTHER:—Are there any further remarks on this report?

THOMAS J. FAY:—What was the reason for raising the phosphorus and sulphur limits. They were already very high, certainly high enough for anything in the way of specifications.

CHAIRMAN SOUTHER:—The answer is this, as near as I can discover it: that .045 phosphorus would produce commercially as good results as any other; that is, assuming treating practices, rolling practices and other manufacturing processes are as exact as they are. There are highly specialized articles, for example, ball bearings, in the case of which that amount would not be right, but in ordinary usage that amount has been demonstrated to be, as far as we can discover from most producing and consuming interests, perfectly safe. Sulphur produces seams, which are inspected out before the consumer ever gets the steel. Phosphorus produces brittleness, and is more important, but it has not been discovered that .045 is dangerous in any respect. In the American Society for Testing Materials that was arrived at from an entirely different standpoint, from another type of users, another class of thinkers, we might say.

The limits are set where they are because they make a commercially obtainable steel, which is perfectly safe to put into any motor car except in rare cases and rare usages. We are not trying to take care of the exception; we are trying to take care of the rule.

K. W. ZIMMERSCHIED:—I think we have taken care of such cases as ball bearings, with sulphur and phosphorus .03. And in cases where high sulphur would give trouble with high carbon, it is down to .04.

CHAIRMAN SOUTHER:—We have not attempted to specify anything below .03. .02 is commercially possible but a very great deal of selection must be used at the mill in order to get it. With Swedish steel, for example, I would say the average runs below .02, but there will be a whole lot in between .02 and .03. Yet Swedish steel is unquestionably good, Swedish stock, in the crucible.

THOMAS J. FAY:—Some of it, Mr. Chairman.

CHAIRMAN SOUTHER:—A very wide range of Swedish steel is good Of course, there are exceptions.

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THOMAS J. FAY:—I think that in the Swedish steels there is anything you like, from the worst to the best. Swedish ores carry anything that you may get, from the very worst to the finest in the world.

CHAIRMAN SOUTHER:—I have yet to find the worst. I have not seen them all by any means, but in those I have run across, I think I have not seen sulphur or phosphorus running above .03 or .035.

THOMAS J. FAY:—You can get anything you want. In the meantime, anything over .04 sulphur and phosphorus would seem to me scarcely worth specifying. You can get that without specifying.

CHAIRMAN SOUTHER:—The question is as to the disposition of this report. You recall what we have been doing, not exactly minimizing but reducing the number of specifications. If we minimized we would cut down to very much fewer than presented. Then also we are reaching out for physical data corresponding to steel specified chemically. We would like very much suggestions for the future topics of discussion for the Iron and Steel Division. Is there anything further wanted?

PRICE OF STEEL

W. M. NEWKIRK:—We might be interested to get some information from steel manufacturers as to the possible effect on prices of standardized specifications such as these; whether they mean putting a fancy price on things or the opposite, as the committee had supposed.

J. G. UTZ:—Is there any means of knowing if the S. A. E. specifications have raised the price of steels?

CHAIRMAN SOUTHER:—I imagine the purchasing departments of the various organizations would say something on that.

THOMAS J. FAY:—They would be the best people to go to, rather than the steel mills. If we go to the steel mills and ask them if they would raise the price if we asked for a certain quality of steel, they would probably say yes. But if we find out from people who are really using it, and know what they specify, we might get some information.

J. H. PARKER:—I think the purchaser can answer that question, by comparing the prices of products now covered by the specifications as against the same products four years ago.

CHAIRMAN SOUTHER:—When they were sold under brand names, you mean?

J. H. PARKER:—Yes, in every case that I know of the prices are lower than they were four years ago.

W. M. NEWKIRK:—That has been my experience. I was a little surprised when Mr. Fay took the opposite position.

C. F. W. RYS:—The standard of the S. A. E. has brought about a smaller number of grades to be manufactured, because orders for steel are coming in more and more in accordance with the S. A. E. standard and are not as varied and as many as they were before the standards were established. Standardization of the orders for steel always tends to decrease the price. The mere fact that the steels are ordered under the S. A. E. specifications does not mean that the manufacturer will increase his price.

THOMAS J. FAY:—I visited some mills the other day which held ex-

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actly the contrary position. As a matter of fact, they disagree with the specifications. I am not talking about a little mill, either. I was surprised to find that such large mills were not in sympathy with the specifications.

I think the specifications are worse than useless unless they represent approximately the current practice, and are a load to carry unless they hold pretty closely to quality, giving to the buyer freedom to lower the standard if he sees fit. That is up to him, the fixing of a standard of quality that is as high as the standard of price. Now whether or not the steel mills are in accord with these specifications, I think is a very open question. As to whether the users are in accord with them, I do not believe that matter is settled at all.

K. W. ZIMMERSCHIED:—I think the fact that the steel makers were not in accord with the S. A. E. specifications a month ago is due more to our sulphur and phosphorus limits in the specifications of the carbon steels, than any other one thing. They were too low. There has been brought to my attention within the last year on at least half a dozen different occasions when large orders were in sight, correspondence of this nature: "We have requested from such and such a steel mill prices on, we will say, fifty tons to a thousand tons or five thousand tons of steel, according to the S. A. E. specification No. so and so. The mill writes back that they cannot meet this specification at the market price, because of the low sulphur and phosphorus figure. Will you please specify whether the mill is trying to stick us or whether your specifications are wrong?"

In every case we have had to write back and say that "These are the figures set up by the S. A. E., but they do not represent the current practice. The current practice is .045 sulphur and phosphorus."

With regard to carbon steels, the reduction in price has not been very much over what it would have been otherwise. But the alloy steels have been cut in price to from 15 to almost to 50 per cent. of what they were before the S. A. E. specifications became general. That has been our experience.

CHAIRMAN SOUTHER:—Of course, this thought leads one very much further back. A good many years ago very ordinary steels, extremely ordinary steels, went under brand names, which carried a value, and for which we paid without getting anything at all. The next natural step was to point out as plainly as possible that which could be asked for reasonably without any brand name value, artificial value. Our specifications do that. Looking at the subject from that standpoint, the reduction in price is simply enormous; there is no question about it. But that is not a fair statement from our present viewpoint. We this day and date should not go back fifteen years or any other sum of years like that and say that we are saving four or five cents a pound on an eight cent steel, although as a matter of fact we are. We are buying the same steel and very much better steel for four or five cents a pound less than we did some years ago. Now these specifications are the plain English language for something that can be obtained in the market as near as the producer and consumer can come together in the market. If you ask for

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lower sulphur and phosphorus than this, you pay the price. I am not saying it is not worth while. If you get anything worse than this you may get into danger, but here is the safe point, recommended practice, good practice for all except the exceptional job. I think that is a fair statement.

This report will, of course, not come before the Society until June, and is now a report of progress, indicating which way we are headed. We will probably have one more meeting of the Iron and Steel Division between now and the June session of the Society. We are only too glad to get the suggestions we have had given us today. They are food for thought. The committee may get into a rut in its habit of thought. This sort of jogging up is all right, excellent, and will be taken notice of in our meeting, no question about that.

The report will come before the Standards Committee once more before it is submitted to the Society for acceptance. This meeting has brought out the criticism of changes that have been made up to this moment.

SECRETARY CLARKSON:—The report has to be approved by the Council as well as the Standards Committee before it can be submitted to the Society for acceptance.

MOTOR TESTING DIVISION REPORT

PROF. R. C. CARPENTER:—The Motor Testing Division considered forms and blanks for reporting the data on the results of commercial tests of motors, that is, such tests as would be likely to be made to secure data for commercial purposes. These tests are not as complete as scientific tests. Particular attention was given to the forms and blanks which were submitted at the last meeting of the Society. I think we have them in shape, or very nearly in shape, for publication.

The Division has decided that it is desirable to prepare a code of rules to accompany these blanks for use in commercial testing. This code will give merely necessary directions for carrying out the tests. It will be made as short as possible, and tend to explain the use of the blanks.

It has been decided also that it is desirable to prepare a code of rules covering scientific motor testing. This code will be more complete and full, taking up discussion of heat transfer, the efficiencies, and all such subjects which are not included in the first named code.

CHAIRMAN SOUTHER:—Gentlemen, you have heard this report of progress. Are there any suggestions which you can make for the benefit of the committee?

J. G. UTZ:—Are these tabulations to be printed and distributed among motor manufacturers for use in laboratory work?

PROF. R. C. CARPENTER:—Yes, these forms are to be printed by the S. A. E. for use in all forms of motor testing.

J. G. UTZ:—So that they can be purchased in quantity from the Society?

PROF. R. C. CARPENTER:—Yes. Those to be used in connection with the code will be accompanied by brief directions for making the tests.

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CHARLES ETHAN DAVIS:—I understand that the idea is that the blanks will enable a manufacturer to make tests along a standard line of procedure?

PROF. R. C. CARPENTER:—Using the same method. It will put all the motor testing on a uniform basis. All the practical data reported will be uniform, so that it will be possible to compare the results. It should also tend to give more accurate information as to actual horsepower and the relation of the same to the speed.

CHARLES ETHAN DAVIS:—It does not mean that any official approval of the tests is made?

PROF. R. C. CARPENTER:—No, but ordinarily the tests will be just as correct as if made officially.

CHAIRMAN SOUTHER:—This method does not contemplate an official approval of any test. Blank forms are provided in order to have tests of gasoline automobile motors made along certain definite lines. As it is now, one man reports in one way and another in another way, and it is necessary to go to a great deal of trouble in converting the various units. In the forms and blanks the curves will all be in the same terms, so that an ocular comparison can be made.

PROF. R. C. CARPENTER:—Likewise, one man draws a correction curve one way, and another in another way. If you stop to think of that, you will see what the result is. But here all is arranged for in one form. We have attempted to work out characteristic curves, horsepower in relation to speed, fuel consumption in relation to speed, and torque in relation to speed.

W. R. STRICKLAND:—The forms should be furnished at a moderate price, so that they can be used very generally throughout the laboratories. I presume that every one has a form of some kind?

CHAIRMAN SOUTHER:—That is the intention. The forms could hardly be used for a better purpose. On the top of the sheets are found the words: "S. A. E. Motor Testing Form No. 1." No one could say that the S. A. E. made the test.

N. B. POPE:—People who knew nothing about it might be misled accidentally or wilfully.

CHAIRMAN SOUTHER:—Could not that be controlled by a note saying, "The Society is not responsible for information conveyed in the blank."

MOTOR SPEED

W. R. STRICKLAND:—Do the forms show no greater speed than 2,000 r.p.m.? I think it will be greater. The tendency will be in that direction. Now is the time to change it.

PROF. R. C. CARPENTER:—That was discussed in committee some time ago, and it was decided that 2,000 r.p.m. will take care of the average motor today. Of course, if conditions change and we have to deal with higher speed motors, the ordinates would have to be changed for the particular motors. I think you will find that ninety per cent. of the motors built today come within the limits given here. The same question was raised as to maximum horsepower. That is fifty in the

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forms. Some people are now building larger motors, but this was thought to be the best for the average conditions. The forms could be produced for a number of different conditions, if thought advisable. The forms would be the same, but the ordinates would be changed.

We discussed 3,000 revolutions instead of 2,000, and 75 hp. instead of 50, but in using the former the curves would be too small for the majority of motor tests.

HERBERT CHASE:—The units could be doubled in any case where necessary to get a higher range. It was thought best to put the co-ordinates on in some form, and not leave them to the discretion of the person making the chart, so that the data would be comparative.

CHAIRMAN SOUTHER:—There might be given the statement "For higher speeds or greater horsepower, the revolutions per minute and horsepower spaces may be given double value."

B. B. BACHMAN:—Why not have a double row of figures printed on the sheet, and let the man who is making the test scratch out those he does not want to use?

CHAIRMAN SOUTHER:—If you get above 2,000 with any "decent" sized engine, you run over 50 hp.

R. McA. LLOYD:—If you made it 2,400 r.p.m., you would cover ninety-nine per cent. of the motors for the next five years.

W. R. STRICKLAND:—You may have a motor that will give maximum power at 2,200, and go to 2,700 to get the fully developed curve. You could not use the form for a case like that.

CHAIRMAN SOUTHER:—I think 2,000 is a little short on revolutions as things are moving.

B. B. BACHMAN:—Is it necessary to go all the way down to zero?

CHAIRMAN SOUTHER:—I have been thinking of that, Mr. Bachman. In reading a motor curve I like to follow it and see if it goes to zero. Otherwise, I suspect there is something wrong at the lower end of the curve. I favor retaining the zero lower limit.

HERBERT CHASE:—I cannot see any objection to having two sheets, one intended for high-speed motors and one for medium-speed.

R. McA. LLOYD:—Do you not think it is more desirable, for purposes of comparison, to have one sheet?

HERBERT CHASE:—Will not most of the high-speed motors built develop less than 50 hp., that is, those that run much above 2,000?

W. R. STRICKLAND:—The motor I had in mind developed 60 hp. at 2,200 r.p.m.

CHARLES ETHAN DAVIS:—I think the 3-inch Knight motor will develop 51 hp. at 3,000.

CHAIRMAN SOUTHER:—Suppose we request of the committee careful consideration of these points on furnishing some forms upon which test results of high-speed and high-horsepower motor can be reported.

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SPARK PLUG MATTERS

J. G. UTZ:—The Miscellaneous Division has some definite progress to report and some indefinite matter to lay on the table. We had present at our meeting today representatives from spark plug manufacturing companies. It seems that the last revision of the spark plug standard brought about some misunderstanding. Conditions arose wherein it was necessary to use larger porcelains. In order to permit the use of these the Miscellaneous Division proposed an additional size for the portion of the spark plug shell above the thread.

CHAIRMAN SOUTHER:—An additional size of plug?

J. G. UTZ:—The hexagonal portion of the body above the thread. This caused confusion because the spark plug people thought we had thrown out the old standard and put in the new one, whereas our recommendation was merely to make an addition. To clear this up, the committee expresses the thought that the enlargement of the hexagonal portion was brought about to permit the spark plug makers to use larger porcelains, but it was not the intention to disturb interchangeability with the previous standard. The standard now permits two sizes of hexagonal body, 7/8 inch across the face and 1 1/8 inch across the face, both using 7/8-18 thread.

We discussed some of the details relative to the drawing that appeared in the February Bulletin, and from the revision and modifications we are going to prepare two new drawings to be published at an early date, offering the matter for final acceptance at the Summer Meeting of the Society.

YOKE AND ROD END PINS

Further consideration of the standard yoke and rod end pins was brought up and the table previously prepared modified and all the changes incorporated in it. This also will be published in the Bulletin, with a request that it be accepted by the Society at the Summer Meeting.

UNIFORM LICENSE PAD

At our recent meetings we have had long discussion of and made some headway in the matter of a uniform license pad, with particular reference to the possibility at some future time of national registration of cars. Between now and our next meeting we are going to correspond in round-robin style, incorporating some of the suggestions and arguments we have heard this morning.

One thing we are trying to work out is some numbering system with prefix or suffix letters that will permit of expansion to handle all the cars in the United States. This would mean a considerable number, but the matter is not so difficult as it would seem, because using the letters of the alphabet, barring say *I* and *O* and some others that might be confused

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with digits, with either four or five numerals between them, an enormous amount of different numbers will result. I believe it can be run close to two million, if necessary.

CHAIRMAN SOUTHER:—Did you take up the color scheme at all, as to whether it should be anything but black and white?

J. G. UTZ:—That was carried along for later consideration. The more we study it the more we are impressed with the size of the whole problem. It would be necessary to agree upon the size of the pad and of other things which could be attached to it; giving, for instance, a system whereby a car owner would have, say, a license number A-8888-Z this year and the same number the next year and in subsequent years, merely buying pads from his State, or from the federal government in the event of national registration. The number of the year might be riveted onto the license pad or plate. Additional pieces could be riveted on to cover such matters as the name of state, ownership by car dealers or manufacturers and the case of one company operating more than one car, not being either a dealer or a manufacturer.

CHAIRMAN SOUTHER:—Mr. Utz, why should a manufacturer be treated differently from any one else? Suppose a manufacturer is running 100 cars. Why should he not have a differently numbered pad for each car?

J. G. UTZ:—The added tag might come in to play there. A manufacturer having a number of cars on the road could have little additional tags numbered 1, 2, 3, 4, and on up according to quantity or cars, which would be hung on the main license pad to identify the different cars owned.

CHAIRMAN SOUTHER:—It is one big subject, as Mr. Utz says, and we must not attempt to discuss it fully here, because the Miscellaneous Division will undoubtedly cover all the other points involved, and we have not the necessary time at our disposal here.

W. R. STRICKLAND:—What has been done to standardize the method of bolting and spacing? I think that should be decided first. I think the pads should be made uniform.

J. G. UTZ:—I imagine it would be difficult to do that at this time. We are working towards it. We have a series of photographs of all the state licenses. The subject is so large that we hardly know where to begin. The present state licenses have many forms, from diamonds to triangles and parallelograms; and include screens, plates punched full of holes and leather tags to put the numbers on; a frightful assortment of contrivances.

CHAIRMAN SOUTHER:—Some of the numbers are six inches high and some are three inches high.

J. G. UTZ:—Some of them are sixteen inches long.

W. R. STRICKLAND:—Is that not largely because each state has nothing definite on which to proceed?

CHAIRMAN SOUTHER:—Absolutely.

W. R. STRICKLAND:—Do you not think that if we put forth a drawing showing a good form of license plate, and a good way of attaching it

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to the machine, one by one the states would adopt it, gradually bringing about their general use?

CHAIRMAN SOUTHER:—My hope as an individual was that the Michigan size of pad would be adopted and all letters or words taken away, numbers simply being used.

W. R. STRICKLAND:—I think we should recommend a standard size.

E. H. EHRMAN:—We must start with some size and character of digit and letter that will be acceptable. If we have a number combination, we must decide in what shape the year will be indicated on the tag, whether it shall be put on as a number or a small plate or escutcheon, including its position. Until that is determined we cannot do very much with reference to the bracket part of the design. Then, again, a shape has to be developed that will not offer too much wind pressure at the front, or be too long to attach to the lamp bracket at the rear.

In answer to the points brought up, I will say that I have copies of the state license tags of nearly all the states, with perhaps only five or six exceptions. I have also copies of the state statutes bearing on the subject. Most of them specify in detail the height of the figures, the stroke, the height of the initials of the state, some of them the position of the state seal; as well as the size of the license pad. Nearly all of these laws would require modification.

J. G. UTZ:—Here is one idea (exhibiting a number of photographs of license pads) with the individual seal issued by the state governments to be tagged on, showing different color schemes, blue and white alternating, or red and yellow, or any alternative combination that would be quite different. The names of some of the states are long, of course, and would require considerable room unless they could be abbreviated.

CHAIRMAN SOUTHER:—If there were a federal license, there would be no state name.

J. G. UTZ:—Federal registration is too far away. What we want to do is to be able to conform to the federal law when it comes along, without making the whole system we hope will be in effect theretofore, obsolete.

Here is the Michigan pad. Here is the Ohio tag, which is a little larger. It might be interesting to note the license tags from the various states that are to be contended with. I may say that all the manufacturers' numbers in Michigan start with 5.

E. H. EHRMAN:—As a matter of fact, only three states will need four digits, besides a letter of the alphabet; California, Illinois and New York. The rest can all get along with three digits and a letter.

J. G. UTZ:—We will try at the next meeting to cover something like that. I agree it would be fine, if we could get that one thing started. At the same time we figure we want to recommend a pad of a specified height. That is the only thing we can determine on early with regard to outside dimensions. That will permit of some of the other proposed ideas later, height of letters, place for the state seal, the individual number, etc.

N. B. POPE:—I would not advocate putting anything on the tag but the numbers, except possibly a state designation or seal.

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J. G. UTZ:—You must have the attachment for the succeeding year.

E. H. EHRMAN:—In Illinois each automobile owner, if he applies for his license before December 10th, can have the same number continuously from year to year.

CHAIRMAN SOUTHER:—I think we could provide a size and style of license tag which would meet with general approval, and that the legislators would be pleased to introduce bills making it the legal pad in their respective states.

J. G. UTZ:—We will try to submit something along that line at our next meeting.

NOMENCLATURE

Chairman Cumner reported briefly as to the current procedure of the Nomenclature Division.*

HOWARD MARMON:—If a list could be prepared comprising words used by the purchasing departments it would probably be a good angle to start from. Our own purchasing department has complained bitterly about the variety of words used to designate the same article.

CHAIRMAN SOUTHER:—Your idea is, Mr. Marmon, that as many purchasing departments as possible should send in their language expurgated?

HOWARD MARMON:—Yes, sir.

A. B. CUMNER:—That is what the committee requests. We find that if we should start a list we would have to rehash the literature of the entire industry and of the Patent Office, etc. It was thought best to confine ourselves to the matters specifically referred to us, whereon there is a difference of opinion.

HOWARD MARMON:—I would suggest that an attempt be made to get a list of the parts of the engine, for example, from the different manufacturers.

CHAIRMAN SOUTHER:—In that way the committee would see what differences do exist in actual practice. Is that the idea?

HOWARD MARMON:—Yes, sir. For example, the wristpin and piston pin—

CHAIRMAN SOUTHER:—And gudgeon pin.

A. B. CUMNER:—All three of those names are used. You will find in the June, 1911, report of Nomenclature Division a list in which "piston pin" was recommended as the proper term. That report, however, was not accepted by the Society, and the recommendations contained therein did not therefore receive sufficient publicity to come into general use.

CHAIRMAN SOUTHER:—It seems to me the thought is this: If we decide upon a given word and it appears in the Data Book, it will become a term of the art or industry, and in that way spread and become universal.

A. B. CUMNER:—I would ask, Mr. Chairman, that the different Divisions of the Standards Committee take occasion to refer any question as

*See page 32, this Bulletin.

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to terms or names, to the Nomenclature Division before deciding on it. That relates, of course, to names other than those of common usage. Let the Nomenclature Division be the reference department. We promise quick action. Let us decide on something, even though it receive adverse criticism.

CHAIRMAN SOUTHER:—It is a vexing question. The only thought in my mind is that the Nomenclature Division take the initiative and then let us pull them down if we can. I find that is the way to make progress. If they are afraid of criticism they had better not do it, as they will get criticism.

There is no definite action or recommendation, and there is nothing to refer back except the suggestions we have heard.

ELECTRICAL EQUIPMENT DIVISION WORK

W. H. CONANT:—The Electrical Equipment Division took up yesterday the matter of fuses in lighting and starting circuits. We agreed that fuses should not be recommended between batteries and starting motors.

It was agreed to ask again for definite replies from the manufacturers of cars and electrical parts, as to their preference as between single- or double-wire circuits. We hope at our next meeting in May to make a definite report of Recommended Practice concerning the regular use of single- or double-wire systems.

We agreed to call to the attention of the Society the necessity of investigating promptly, with a view to definite action, the matter of headlights. We would like to have the Society suggest regulations in relation to the proper control, dimming or handling of headlights. The Division recognizes the need of doing something now, more particularly because left-side driving is becoming so nearly universal. The point was brought up that two left-side drivers approaching each other, do not escape the range of the left-hand headlight until they are practically abreast.

CHAIRMAN SOUTHER:—Does it require inventive genius for two men approaching each other, each with a switch in hand, to turn the headlights off?

W. H. CONANT:—If the lights are turned off suddenly, the drivers cannot see. If they are dimmed to prevent glare, they throw insufficient light. If auxiliary lights are used they act as pilot lights without shedding light on the gloom.

The suggestion was advanced by Mr. Riker that the left-hand light be turned out on approaching another car. You escape the right-hand headlight much sooner. But that is only a make-shift; something else must be done.

HOWARD MARMON:—The various Councils are legislating headlights out of town. I do not see why that is not a good scheme. A sidelight is ample for everything but country-road driving.

E. R. HALL:—Would it be possible to arrange a reflector to change the direction of the full force of light; and to throw the light on the road so that the driver approaching can have all the light necessary?

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CHAIRMAN SOUTHER:—You mean tip both lights so that they focus down?

E. R. HALL:—Either that, or cut off that portion of the reflector which throws the light up.

CHAIRMAN SOUTHER:—I think we cannot invent the right thing here. I am glad, however, that the subject is being considered.

Mr. Conant, one thing has come up in the last few days:—What is the voltage tendency in lighting and starting now?—up or down?

W. H. CONANT:—The best reply I can make to that, Mr. Chairman, is that yesterday at our meeting I hazarded the prediction that in the near future we would be using higher voltages, and I found almost instant agreement. My personal opinion is that twelve volts will become more widely used. There are now voltages used ranging from six to twenty-four and those who have observed the tendencies in similar lines during the past few years, believe it will settle somewhere between those two limits, possibly as high as sixteen.

Generally speaking, electrical engineers favor higher voltages, and motor car manufacturers are coming to see some of the advantages of them. One of the most interesting signs of the times from our viewpoint is the way manufacturers of cars are calling in electrical engineers, either in consulting capacity or as a part of their regular organization.

I feel confident that the six-volt standard, if we might call it such at present, is in a transitory stage.

On motion, the meeting adjourned to June 23 (2 p. m.), at Cape May, New Jersey.

COKER F. CLARKSON, Secretary.

NOTES OF APRIL DIVISION MEETINGS

BALL AND ROLLER BEARINGS DIVISION

The Ball and Roller Bearings Division (Howard Marmon, Chairman), has started upon the task of reducing the number of stock sizes of roller bearings in the case of sizes which are not interchangeable with the dimensions which have already been accepted for ball bearings.

BROACHES DIVISION

To the circular letters regarding four-spline practice recently sent out to the chief engineers of approximately fifty automobile manufacturers, twenty-three replies were received by C. W. Spicer, Chairman of the Broaches Division, up to the time of the meeting. Of these ten were using four-spline shafts and thirteen were not.

As to equal division of the periphery, five objected and three were in favor. Of those who objected, only two gave the same reason. This reason, however, referred to manufacturing cost, as did one other reason given. Therefore three favored the unequal division, thinking it cheaper to manufacture, whereas two favored the unequal division in order that a larger bearing on the small diameter of the gear might be obtained.

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After careful consideration of the various points brought out in connection with the replies summarized above and of such other conditions as the members of the committee present were in position to bring up, the chief reasons for equal division of the periphery may be summarized as follows:

Equal Division

1. Uniformity in general design with the six- and ten-spline proportions already accepted.

2. In the milling operation there would be less material to be removed and surface to be covered; therefore less cost.

3. In the grinding operation there would be less surface to be covered; therefore less expense in manufacturing.

4. The shaft would be stiffer.

The foregoing enumerated advantages of the equal division appear to the committee to have much less weight than the reasons for unequal division considered, which were as follows:

Unequal Division provides:

1. Larger bearing surface on the small diameter. This is especially important when auxiliary grooves are provided at the root of the spline of the shaft, which grooves are in some cases necessary in order to develop the necessary depth of straight surface on the side of the spline when the spline is developed by the hobbing process. The auxiliary groove is also of advantage when the small diameter of the shaft is finished by grinding, as it obviates the necessity of grinding up into a sharp corner.

2. Lighter shaft.

3. Less material to be removed by the broach and therefore less expensive broaching operation.

4. Other things being equal, a gear or other part containing the broached hole would probably go out of shape in heat-treating somewhat less if provided with narrow slots than it would with the comparatively wide slots resulting from an equal division of the periphery.

Of the replies summarized above, one only, from C. S. Crawford of the Cole Company, contained recommendation of any specific proportion. He recommended that the width of the splines represent from 35 to 40 per cent. of the outside periphery of the shaft.

The Division decided to go ahead on a design which should be a modification of the various views expressed in the replies mentioned above and which seemed good design, namely that after subtracting from the periphery an amount of surface suitable for the eight auxiliary grooves, which in actual construction might or might not be used as the designer should elect, the remaining portion of the periphery be approximately equally divided.

DATA SHEET DIVISION

The Data Sheet Division (B. D. Gray, Chairman), which has in charge the issuance of supplemental and superseding sheets for the S. A. E. Handbook of standards and recommended practices and general

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engineering data applicable to the automobile field, is very active and at its last meeting formulated recommendations as to methods of disseminating widely at nominal cost separate copies of the official version of S. A. E. practices.

The present data book is of approximately the same size as other data books and is more convenient for use in drafting rooms and filing as well as more convenient for carrying, than a book of greater length and width would be. Most of matter thus far printed and to be printed in data sheet form can be put on the present size sheet to very good advantage and it does not seem desirable to provide larger sheets for other than the comparatively small percentage of material which cannot be put conveniently on the present size sheet. Where necessary or advisable, however, matter will be printed and issued to the members on letter-size sheets, 8½" x 11", in conformity with the recommendation of the Data Sheet Division and the approval of the Council. The sheets will probably be punched on the short edge for insertion in loose-leaf folders. Data sheets hereafter issued by the Society will be marked "official publication."

ELECTRICAL EQUIPMENT DIVISION

The Electrical Equipment Division (A. L. Riker, Chairman), took up the matter of installing fuses in circuits from storage batteries as applied to both two-wire and single wire systems. A long discussion was also had to the best methods of controlling the rays of headlights in such a way as to insure comfortable and entirely safe country driving.

ELECTRIC VEHICLE DIVISION

The meeting held this month was the first one of the Electric Vehicle Division. The Division proceeded with temporary organization, being in consultation with the delegates from the Electric Vehicle Association Standards Committee. It was the sense of the meeting that the Society of Automobile Engineers should be requested to have more electric vehicle representatives on the different Divisions of the S. A. E. Standards Committee wherein the work is common to both gasoline and electric vehicles.

IRON AND STEEL DIVISION

The Iron and Steel Division (Henry Souther, Chairman), checked carefully the minutes of its last meeting and considered and approved forms which will be used for securing in tabular and curve form data so far as possible as to the physical properties of S. A. E. steels.

The prospect is that the Iron and Steel Division will recommend that about half of the previously accepted eighty specifications of S. A. E. steels be eliminated; also that in the case of some steels the previously accepted content of phosphorus and sulphur be raised.

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Another meeting of the Iron and Steel Division is scheduled to be held during the next two months, for the purpose of considering and collating data of physical properties of S. A. E. steels, and settling finally upon the recommendations to be made in its next report to the Society, the report so far as formulated at present having been discussed at the meeting of the Standards Committee held this month. According to the regular procedure the Iron and Steel Division report, before being submitted to the Society for acceptance, will be again discussed at a meeting of the Standards Committee, when approved by the Council of the Society.

MISCELLANEOUS DIVISION

The Miscellaneous Division (John G. Utz, Chairman) recently recommended the spark plug with larger hexagon head to permit the employment of larger porcelains without disturbing interchangeability with the previously accepted standard, the A. L. A. M. spark plug, the name of which was changed to S. A. E. some years ago.

A complete table of dimensions of pins for S. A. E. standard rod and yoke ends was submitted.

MOTOR TESTING DIVISION

Professor R. C. Carpenter, Professor J. A. Moyer, William Guy Wall and Herbert Chase attended the meeting of the Motor Testing Division at which time the three motor testing forms submitted at the last meeting of the Society were further considered and it was decided to draw up a code for use in connection with the conduct of motor tests.

NOMENCLATURE DIVISION

The Nomenclature Division (A. B. Cumner, Chairman), limited its proceedings to formal discussion as to the plan and scope of future activities. A vote was passed requesting the Council to instruct the various Divisions of the Standards Committee to refer to it all questions involving nomenclature. The Division is co-operating with the Nomenclature Committee of the British Engineering Standards Committee, which is supported by the English government and represents the leading engineering societies and firms of Great Britain. Mr. Charles Wheeler, a member of the Council of the Institution of Automobile Engineers, who attended the last summer meeting of the S. A. E., is Chairman of the British nomenclature committee. A letter from him was read at the Standards Committee meeting announcing that he was sending for the consideration of the S. A. E. Nomenclature Division, a list of words and phrases which is now under the consideration of his committee.

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PLEASURE CAR WHEELS DIVISION

The Pleasure Car Wheels Division took under consideration the results of an extensive series of tests of rims conducted by E. R. Hall. It was thought that in view of these tests it had been demonstrated that the figures for deflection and permanent set of rims under specific test, contained in the First Report of the Division, submitted at the meeting of the Standards Committee held in January last, but referred back to committee, were justified. (See December, 1913, Bulletin, p. 214.)

The Division expects to make recommendations which will reduce the commonly used sizes of pneumatic tires to twelve, in any event not more than sixteen. At the present time some of the tire companies are listing fifty different sizes.

Eight tire sizes which the Division decided to recommend are shown in the following table:

Rim Sizes	*Tire Sizes*				*Tire Seat Diameter*
30 x 3	30 x 3				24"
30 x 3½		30 x 3½			23"
32 x 3½		32 x 3½			25"
32 x 4			32 x 4		24"
34 x 4			34 x 4		26"
34 x 4½				34 x 4½	25"
36 x 4½				36 x 4½	27"
38 x 5½				38 x 5½	27"

This table, it will be noted, involves only eight rim sizes, and five tire seat diameters. One or two other regular tire sizes are under consideration by the Division.

It was thought by the Division that tire oversizes should not be recommended for regular equipment.

The British standards of one-piece clincher rim sections which are in force in Europe today and which it was reported had been approved by the Clincher Automobile Tire Manufacturers' Association of Cleveland, Ohio, for millimeter sizes (the American sizes being, of course, in inches), were considered. There were some apparent discrepancies in the stated tolerances from precise measurement of the British Standards, upon which more information is being sought. It is the intention that there shall be ready for presentation at the next meeting of the Society a paper setting forth the difference in American and European practice in this regard.

A number of wheel-makers attended the meeting of the Pleasure Car Wheels Division to take part in the discussion of the possibility of standardizing wood wheel dimensions and felloe bands for pneumatic tires. A number of drawings and sketches were submitted to elucidate the subject, the situation as to which appears at this time to be that it is probably feasible to recommend two sets of dimensions which will cover the practice. It was hoped that one set of dimensions could be recommended, as has been done by the Society in the case of solid tires, but whether this can be done will be discussed in a paper to be presented at a later date.

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RESEARCH DIVISION

At the meeting of the Research Division scheduled for April, the following were present: Professor D. L. Gallup (Chairman), Professor James A. Moyer, Professor C. B. Veal and H. L. Thomson. The Division took under consideration the making of tests to determine proper sizes of tap drills, a subject which the Data Sheet Division took up with a view to decreasing the breakage of taps, and which after a preliminary investigation by the Data Sheet Division, was by its request referred to the Research Division, through the Standards Committee and the Council of the Society.

SPRINGS DIVISION

The Springs Division (Harold L. Pope, Chairman), is formulating a table of axle clips for use on pleasure cars, with the idea of reducing the number of sizes and submitting a design of clip that will represent the best engineering practice. Correspondence is being conducted with axle and clip manufacturers with a view to securing complete data bearing on spring clip dimensions. Data have already been collected from a large number of automobile engineers showing the practice as to the diameter of spring clip shank with relation to the width of leaf springs and giving information as to the best methods of reducing to a minimum breakage of short spring leaves.

The Committee appeared to favor the use with center bolts of springs of U. S. standard hexagon nuts tapped with S. A. E. screw standard thread. Also that nuts for spring clips have a length of one and a half times the diameter of the clip shank.

It is planned to hold another meeting of the division prior to the meeting of the Society to be held at Cape May in June, commencing on the 23rd.

EYE BUSHING AND BOLT TOLERANCES

The Division recommended that the tolerance on bushed eyes of leaf springs be changes from + .000 (recommendation accepted at the January, 1913, meeting of the Society)
— .002
to + .002
— .001

Also that the tolerance of bolts for bushed eyes be changed from
— .003 (recommendation accepted at the January, 1913, meeting of the Society)
— .004
to — .002
— .004

Also that the tolerance of eyes not bushed be changed from
+ .000 (recommendation accepted at the January, 1913, meeting of the Society)
— .005
to + .002
— .001

Also that the tolerance of bolts for eyes not bushed be changed from
— .007 (recommendation accepted at the January, 1913, meeting of the Society)
— .008
to — .002
— .004

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REGISTRATION LIST OF STANDARDS COMMITTEE MEETING

Reuben Allerton, Sales Agent, Bronxville, N. Y.
Joseph A. Anglada, Member of Council (Commercial Car Wheels Division) Consulting Engineer, New York.
J. R. C. Armstrong (representing Electric Vehicle Association), Chief Electrical Engineer, General Vehicle Company.
B. B. Bachman (Truck Standards Division), Assistant Engineer, Autocar Co.
H. S. Baldwin (representing Electric Vehicle Association).
R. S. Bryant (Pleasure Car Wheels Division), Consulting Engineer, Standard Welding Company.
C. C. Carlton (Pleasure Car Wheels Division), Firestone Tire & Rubber Company.
R. C. Carpenter (Motor Testing and Research Divisions), Professor of Experimental Engineering and Consulting Engineer, Sibley College. Cornell University.
Herbert Chase (Miscellaneous and Motor Testing Divisions), Laboratory Engineer, Automobile Club of America.
Coker F. Clarkson, General Manager, Society of Automobile Engineers.
C. E. Clemens (Frame Sections and Truck Standards Divisions), Mechanical Engineer, Perfection Spring Company.
W. H. Conant (Electrical Equipment Division), Detroit Manager, Gould Storage Battery Company.
Frank Conrad (Electrical Equipment Division), Electrical Engineer, Westinghouse Electric and Manufacturing Company.
Arthur B. Cumner (Chairman Nomenclature Division), Transportation Engineer, New York City.
Hermann F. Cuntz (Treasurer of the Society), Mechanical Engineer and Patent Attorney, New York City.
Charles Ethan Davis (Lock Washers Division), Advising Mechanical Engineer, New York City.
Arthur M. Dean (Data Sheet Division), Palmer and Singer Manufacturing Company.
E. H. Ehrman (Miscellaneous Division), Secretary and Factory Manager, Chicago Screw Company.
Thomas J. Fay (Nomenclature Division), Manager Rockefeller Motor Co.
Bruce Ford (Truck Standards Division), Fourth Vice-president Electric Storage Battery Company.
Radclyffe Furness, Research Engineer, Midvale Steel Company.
F. M. Germane (Ball and Roller Bearings Division), Assistant General Manager, Standard Roller Bearing Company.
Christian Girl (Member of Council and Springs Division), President, Perfection Spring Company.
B. D. Gray (Ball and Roller Bearings Division and Chairman Data Sheet Division), Vice-president Hess-Bright Mfg. Company.
H. L. Greene, Chemist, J. H. Williams and Company.
E. R. Hall (Pleasure Car Wheels Division), Experimental Engineer, Goodyear Tire & Rubber Company.
P. M. Heldt (Nomenclature Division), Editor of *Horseless Age*.
Russell Hoopes (Commercial Car Wheels Division), Superintendent, Hoopes Brothers and Darlington, Inc.
G. A. House, Manager Sales, Hayes Wheel Company.
F. G. Hughes (Ball and Roller Bearings Division), Chief Engineer and Production Manager, New Departure Manufacturing Company.
F. J. Jarosch (Ball and Roller Bearings Division), Chief Engineer, J. S. Bretz Company.

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Leonard Kebler (Electrical Equipment Division), President, Ward Leonard Electric Company.

A. M. Laycock (Commercial Car Wheels Division), Chief Engineer, Axle Department, Sheldon Axle Company.

T. L. Lee, Northeast Electric Company, Rochester, N. Y.

Henry M. Leland (President of the Society), President and Advisory Manager, Cadillac Motor Car Company.

P. W. Litchfield, Factory Manager, Goodyear Tire and Rubber Company.

Robert McA. Lloyd (Truck Standards Division), Consulting Engineer, New York City.

Wm. V. Lowe (Data Sheet Division), Engineer and New England Representative of Hess-Bright Mfg. Company.

Alden L. McMurtry (Electrical Equipment Division), Consulting Engineer, Sound Beach, Conn.

Howard Marmon, Past President of the Society (Carbureter Fittings, Pleasure Car Wheels and Chairman Ball and Roller Bearings Division), Secretary and Engineer, Nordyke & Marmon Company.

A. J. Marshall (representing Electric Vehicle Association).

R. L. Morgan (Springs Division), Consulting Engineer, Worcester, Mass.

J. A. Moyer (Motor Testing and Research Divisions), Professor in charge of Department of Mechanical Engineering, Pennsylvania State College.

W. M. Newkirk (Springs Division), Mechanical Engineer, William and Harvey Rowland, Inc.

Wm. H. Palmer, Jr. (Electrical Equipment Division), Assistant Engineer, Electric Storage Battery Company.

J. H. Parker (Iron and Steel Division), Metallurgist, Carpenter Steel Company.

H. L. Pope (Member of Council, Data Sheet Division and Chairman of Springs Division), Mechanical Engineer, Pope Manufacturing Company.

N. B. Pope (Miscellaneous Division), Technical Editor, *Motor Trades Publishing Company*.

A. L. Riker (Bearings, Frame Sections, Miscellaneous and Chairman Electrical Equipment Division), Vice-president and Chief Engineer, Locomobile Company of America.

W. H. Roberts (Truck Standards Division), Assistant Engineer, Department of Finance, New York City.

A. J. Ross (representing Electric Vehicle Association).

E. F. Russell (Member of Council, Iron and Steel and Truck Standards Divisions, Longmeadow, Massachusetts.

C. F. W. Rys (Iron and Steel Division), Metallurgical Engineer, Carnegie Steel Company.

Charles L. Schwarz (Commercial Car Wheels and Truck Standards Divisions), Philadelphia, Penna.

Arthur J. Slade (Commercial Car Wheels and Truck Standards Divisions), Consulting Engineer, New York City.

Henry Souther (Chairman of Standards Committee), Vice-president and General Manager, Ferro Machine and Foundry Company.

C. W. Spicer (Chairman Broaches Division), President, Spicer Manufacturing Company.

H. J. Stagg, Jr., Halcomb Steel Company.

E. E. Sweet (Carbureter Fittings and Miscellaneous Divisions), Consulting Engineer, Cadillac Motor Car Company.

W. R. Strickland (Frame Sections Division), Principal Assistant Engineer, Peerless Motor Car Company.

F. W. Trabold (Iron and Steel and Truck Standards Divisions), Manager Sales Department, J. H. Williams and Company.

J. G. Utz (Chairman of Miscellaneous Division), Consulting Engineer, Perfection Spring Company.

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W. G. Wall (Vice-president of the Society and member Motor Testing Division) Vice-president and Chief Engineer, National Motor Vehicle Company.
P. D. Wagoner (Electric Vehicle Division), President, General Vehicle Co.
E. R. Whitney (Commercial Car Wheels and Truck Standards Divisions and Chairman of Standards Committee of Electric Vehicle Association), Chief Engineer, Commercial Truck Company of America.
M. W. H. Wilson (Ball Bearings Division), Assistant Superintendent, Cadillac Motor Car Company.
Henry C. Wilson (Member of Council), Consulting Engineer, New York City.
C. A. Woodruff (Pleasure Car Wheels Division), Assistant Superintendent, American Tube and Stamping Company.
C. B. Williams (Pleasure Car Wheels Division), Treasurer, Mott Wheel Company.
W. S. Zimmerman, Gould and Eberhardt.

MEMBERS OF THE SOCIETY ELECTED DURING APRIL

MEMBER GRADE

Boening, Fred S., Saginaw Sheet Metal Works, Saginaw, Mich.
Bowlzer, A. H., Jr., 8 Davis Court, Lakewood, Ohio.
DeWitt, George William, Munger Auto. Co., Dallas, Texas.
Manly, Chas. M., 250 West 54th Street, New York City.
Martin, Wm. W., Martin Coulter Co., Pittsburgh, Pa.
Merritt, Seneca W., Moreland Motor Truck Co., Los Angeles, Cal.
Overman, M. C., Cornell University Club, New York City.
Peck, Fred. G., Lock Box 14, Station C, Buffalo, N. Y.
Torrence, Geo. P., Jr., Link Belt Co., Indianapolis, Ind.

ASSOCIATE GRADE

Atwell, Edwin, 341 Fifth Avenue, New York City.
Champ, Norman B., Champ Spring Co., St. Louis, Mo.
Gassaway, Frederic S., 136 West 52nd Street, New York City.
Lynn, Thomas H., Lycoming Foundry & Machine Co., Williamsport, Pa.
Moffett, P. R., 1220 Citizens Bldg., Cleveland, O.
Oliver, Morris O., 20 N. Pine St., York, Pa.
O'Malley, John M., 63 Edgewood St., Hartford, Conn.
Oakes, Walter S., 1435 Bellefontaine St., Indianapolis, Ind.
Picard, Sidney L., 511 Cadillac Avenue, Detroit, Mich.
Skilliman, Clarence G., 324 South Front St., Fremont, O.
Terry, Chas. W., 722 Ford Bldg., Detroit, Mich.
Thomson, Arthur G., Joseph Dixon Crucible Co., Jersey City, N. J.

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Members of Council present at April Meeting

J. A. Anglada — Vice-president Wall — Vice-president Zimmerschied — Past-president Marmon — H. C. Wilson — Christian Girl — Treasurer Cuntz — E. F. Russell — Secretary Clarkson — President Leland

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SUMMER MEETING

The members will receive shortly a special circular containing details of arrangements for the Summer meeting of the Society, to be held at Hotel Cape May, Cape May, N. J. Any information required by members in this connection in addition to that given in the circular, will be furnished gladly upon application to the

GENERAL COMMITTEE ON ARRANGEMENTS,
1790 Broadway, New York City.

Mark June 23, 24, 25, 26 in your engagement book as set aside for profit and enjoyment.

TUESDAY, JUNE 23

2.00 P. M.—Standards Committee meeting.
8.00 P. M.—Meeting of Board of Governors of Sections of the Society.

WEDNESDAY, JUNE 24

2.00 P. M.—Business and professional sessions of the Society.
8.00 P. M.—Entertainment by Sections of the Society.

THURSDAY, JUNE 25

9.30 A. M.—Professional Session.
2.00 P. M.—Professional Session.
8.00 P. M.—Dinner and European Trip Lecture.

FRIDAY, JUNE 26

9.30 A. M.—Professional Session.
1.00 P. M.—Adjournment of Professional Sessions.

Baseball games between Sections of the Society in the afternoon.

Games, Tournaments.

SATURDAY, JUNE 27

Competitions in other sports.

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SECOND EUROPEAN VISIT

The itinerary given below of the Second European Visit of the Society is tentative, but in the opinion of the General Committee on Arrangements will not be changed very much in what will be decided upon finally.

ITINERARY

Friday,	Oct.	9th:	Leave New York per SS. *Kronprinzessin Cecile* 1:00 A.M.
Thursday,	"	15th:	Due to arrive CHERBOURG P.M. and proceed direct by special train to PARIS.
Friday to	"	16th	In PARIS.
Tuesday,	"	20th:	
Wednesday,	"	21st:	Leave PARIS 2:20 P.M. for TURIN.
Thursday,	"	22d:	Arrive TURIN 6:00 A.M.
			Leave TURIN 8:00 P.M.
			Arrive MILAN 10:50 P.M.
Friday to	"	23d:	In MILAN.
Saturday,	"	24th:	
Sunday,	"	25th:	Leave MILAN 7:25 A.M.
			Arrive LUCERNE 1:51 P.M.
Monday,	"	26th:	In LUCERNE.
Tuesday,	"	27th:	Leave LUCERNE 9:14 A.M.
			Arrive NEUHAUSEN 12:56 P.M.
			Visit to SCHAUFFHAUSEN.
Wednesday,	"	28th:	Leave NEUHAUSEN 9:37 A.M.
			Arrive STUTTGART 2:03 P.M.
Thursday,	"	29th:	In STUTTGART.
Friday,	"	30th:	Leave STUTTGART 10:03 A.M.
			Arrive MAYENCE 2:51 P.M.
Saturday,	"	31st:	Leave MAYENCE 10:00 A.M. by steamer for COLOGNE, arriving at 7:30 P.M.
Sunday,	Nov.	1st:	In COLOGNE.
Monday,	"	2d:	Leave COLOGNE 9:00 A.M.
			Arrive ESSEN 10:30 A.M.
			Leave ESSEN 5:15 P.M.
			Arrive COLOGNE 6:48 P.M.
Tuesday,	"	3d:	Leave COLOGNE 7:56 A.M.
			Arrive BRUSSELS 11:25 A.M.
Tuesday and	"	3d	In BRUSSELS.
Wednesday,	"	4th:	
Thursday,	"	5th:	Leave BRUSSELS 8:52 A.M.
			Arrive ANTWERP 9:48 A.M.
			Leave ANTWERP 7:00 P.M.
			Thence by steamer to HARWICH and rail to LONDON.
Friday,	"	6th:	Arrive in LONDON about 8:00 A.M.
Friday to			In LONDON.
Saturday,	"	14th:	
Sunday,	"	15th:	Leave by morning train for SOUTHAMPTON and sail by the SS. *George Washington*.
Sunday,	"	22d:	Due to arrive in NEW YORK.

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Presented before Indiana Section of the Society.

CARBURETION—ITS ANOMALIES

By P. S. Tice.*
(Member of the Society)

As time goes on, a more intelligent recognition is being accorded those physical phenomena which inherently occur in the act of carburetion of air with a liquid fuel or its vapor. Each of these several phenomena is in itself an event the progress of which follows an inflexible rule, capable of simple and straightforward statement. But the conditions under which the act of carburetion must go forward bring into the matter variables in the correlation of simultaneous phenomena. And these variables are often most difficult of reconciliation with the desired result.

At the outset, in motor-propelled vehicles, the nature of our fuels places a limitation upon the sort used—it must be liquid. This immediately brings into being the two main problems of carburetion: proportioning of the mixture ingredients; and vaporization of the fuel. While the performance of the two functions of the carburetting device cannot be said to be diametrically opposed in character, it surely does not follow that excellence in the performance of one of them presupposes an equally meritorious result in the other.

It has been stated that there are essentially two problems, namely: proportioning of the fuel to the air; and vaporization of the fuel. Let us first run through the points involved in the satisfaction of each, as if it stood alone; and later let us see the state of agreement or disagreement in the carburetting system following the attempt to make the two functions go on simultaneously.

In the following there will be no reference to this or that type of carbureter, as distinguished from its fellows. In each case and in each make of device the results attempted are, or should be, the same. Starting at this point, the field is cleared for an abstract consideration of the relations of principles and methods.

In all carburetting devices to date, capable of satisfactory use in motor cars, the liquid fuel is brought into the presence of the air with which it is to combine by means of a pressure depression exerted upon the discharge end of a passage so located as to cause the fuel to be carried off by a moving column of air. This is the fundamental point of similarity in carbureters. But here this basic similarity ends, since at least two variations are employed to create this depression on the fuel passage exit. In any case, it is sought to control the quantity of fuel discharged by virtue of this depression to give a relationship, or set of relationships over the range of the motor, between the quantity of air and quantity of fuel aspirated by the motor.

*Engineer, Holley Brothers Company.

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The possible variations in the means and combinations of means used to accomplish this result constitute the most interesting phase of carbureter design, as we know it. All embrace the following two items, either singly or in combination: (1) variable depression on fuel orifice or orifices; and (2) variable fuel orifice or orifices. That the possibly usable variations are almost endless is proven by the great variety of devices with which the market is stocked.

But, whatever may be the means of securing proportioning, and whatever may be the degree of its perfection under constant conditions, it is subject to irregularities as a result of temperature change. By this is not meant seasonal changes of atmospheric temperature alone, since most carbureters provide means for compensating in large measure for this variation. The most mischievous temperature change is that due to the activity, or lack of activity, of the motor itself. Naturally the temperature changes from the latter source are greatest, and therefore most difficult, with low atmospheric temperatures; and, as a consequence, irregularities in mixture proportioning are greater in the cold than in the warm months.

Change in temperature, either of the air entering the carbureter, of the carbureter water-jacket, or of the motor proper, works to change mixture proportions in the following ways:

(a) If the air entering the carbureter is subject to temperature change from moment to moment, or from hour to hour, as is the temperature under the hood of the car, the depression of pressure in the carbureter, with a given throttle opening, is ordinarily changed somewhat inversely as the temperature. This effect, while small, rather tends to maintain than alter proportions. But, unfortunately, it is not unaccompanied by effects of considerably greater magnitude, which operate in the other direction. Not only are the surface tension or capillarity and the internal friction or viscosity of the fuel lowered with temperature increase, making for a considerably higher discharge rate under unchanged depression, but the coefficient of efflux of the nozzle or jet increases with a rising temperature. The converse is, of course, equally true. The result is that mixture proportions cannot be maintained in the face of changing air temperature, without readjustment of the carbureter.

The remedy in this case lies in providing means for running normally with the air entering the carbureter at a temperature considerably higher than the highest atmospheric temperature likely to be encountered throughout the year. Such an expedient, of course, requires a control, automatic or otherwise, to minimize changes in normal air temperature. In this way the effect of air temperature change can be confined almost wholly to the period of "warming up."

(b) If the temperature of the entering air remains practically constant, the effect of a carbureter water-jacket is identical with that noted for change of air temperature. Of course its effect is not nearly so great, since the jet or nozzle temperatures most nearly follow those of the air-stream passing. On the other hand, if both air and jacket temperature vary, the disturbance in this case may be much greater than in a device without jacket.

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(c) In the case of the motor proper being the only temperature variable, conditions, so far as proportioning is concerned, are considerably improved, since the effects upon the carbureter, as noted, will be only those due to atmospheric temperature changes.

In the foregoing no cognizance is taken of the means incorporated in the carbureter to secure proportioning throughout the range of the motor. A discussion of these things would hardly serve at this time, since their merits or demerits, as compared with each other, are matters of personal opinion, rather than facts or truths universally recognized. The fact it is attempted to point is that no matter what the type of device, there is an irregularity in proportioning occasioned by a change in its working temperature.

There are further considerations in the proportioning of the mixture ingredients, but, from the manner in which they are bound up with that other function of the system, vaporization of the fuel, it will be better to take them up later when their full significance can be more easily presented.

It is admitted without question by all who have done work in this direction that the more nearly the process of vaporization is carried to its completion before the ignition of the mixture, the more flexible and responsive will be the motor, and the more economical can be its operation. But in this direction, as in most others, there are limits beyond which it is neither advisable nor necessary to go.

It is coming to be realized that to secure complete vaporization of the fuel before its entry into the cylinders is bootless, since in the cylinders themselves, after they are at working temperatures, we have a most powerful aid to vaporization. Nevertheless, as most of us know, there is much to be done before we can sit back with the bland self-assurance that the process of carburetion is being completed for us by an accomodating motor.

Let us sum up a few of the facts in the case. To get the greatest possible volumetric efficiency in a motor is desirable. This means that mixture temperatures must be kept down. To accelerate the process of vaporization is equally desirable. But this latter in its accomplishment presupposes a heat input, which, unless it can be entirely represented by fuel vaporized before the entry of the mixture into the cylinders, represents a loss in possible volumetric efficiency. It is recognized, of course, that up to a certain point such a loss in volumetric efficiency is, in practice, more than justified by the improved vaporizing conditions. Almost everyone has had experience of this.

Another way to accelerate vaporization, and one, by the way, that should in all cases to be carried to the limit, is to make the most of the heat supply available in the air, without resort to outside or forced supply, by subdividing the liquid fuel as finely as possible upon its entry into the air-stream. Quite remarkable results have been accomplished experimentally in this way.

No matter what is done to the fuel in the way of spraying or atomization, a certain amount of heat must be taken up by it before it can be

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a vapor. This quantity, called the total heat of vaporization, is, for ordinary gasoline of from 58° to 60° Baumé, and an initial temperature of 60° F., in the neighborhood of 370 B.t.u.'s per pound. That the heat of compression alone is several times greater than sufficient to accomplish the transference of the whole of this amount is obvious. But the time in which it can do so is very limited; and, more important still, the fuel is very seldom present in the cylinder in such form as to make so rapid a transfer possible.

The fact that it is not is proven when it is considered that the transfer of 375 B.t.u.'s from 15 odd pounds of air to 1 pound of fuel represents only some 84° to 85° F. temperature drop in the air, assuming no other interchange. In the circumstances, other interchanges do take place, and they are very difficult to measure or eliminate, even experimentally.

The writer has certain data on temperature drop through the carbureter, the temperatures being measured in the air-intake port of the carbureter, and at a point four inches above the jet, which show a maximum drop of 139° F. The carbureter used was one giving extreme atomization of the fuel, and the temperatures used were high, that at the intake to the carbureter being 248° F., and that of the mixture 109° F. Some of this drop is accounted for by direct radiation and convection from the carbureter metal, and by the expansion of the air through the throat-piece surrounding the nozzle; but, in any case, since this was the greatest drop in temperature that could be obtained, it is certain that the fuel was vaporized almost completely even at four inches beyond the jet. With this same carbureter it was found that no gain was made in economy of operation with a temperature drop greater than 76° F.

If it is taken, as it safely may be, that 85 degrees temperature drop, without other interchange, represents complete vaporization of the fuel, then, calculating losses in the same proportion as when the maximum drop of 139 degrees F. was obtained, we have

Total Temp. Drop.		Due to Vaporization.		Loss.
139	—	85	=	54 in the one case, and
76	—	46	=	30 in the other.

From this it appears that when gain ceased from increased vaporization in the carbureter, approximately only one-half of the fuel discharged from the jet had been vaporized. Since it is inconceivable that less than complete vaporization should be conducive to greater economy than complete vaporization, it seems that the heat of the cylinders and of compression can be relied upon to complete the latter and more difficult half of the process of vaporization.

This premise seems to be supported by another experience. In some work on kerosene fuel, preliminary to the design of a carbureter for that fuel, it was found that the most economical mixture temperature, over the whole range of the motor, was 160° F., in face of the fact that vaporization of the kerosene was known to be incomplete in the carbureter at temperatures less than 288° F.

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The above figures are not offered as being conclusive, but only as evidence in support of the statement that, in vaporization in the carburetting system, there are limits beyond which it is neither desirable nor necessary to go.

There is one point on which they are very conclusive, however; a very considerable part of the total heat applied in an attempt to secure vaporization remains in the mixture as a temperature value, thereby greatly reducing the volumetric efficiency of the motor. And this is equally true, no matter in what way the heat is applied.

While on the subject of vaporization, it seems to be well to enlarge a little upon the prime importance of securing a very fine mechanical division of the fuel upon its entry into the air-stream. Not only can vaporization be accelerated in this way without any very extensive recourse to heating and its complications, but, as accompanying advantages, the carbureter becomes less sensitive, the motor more economical and responsive, and, last but not least, loading can be eliminated.

To cite a case in point, as showing the gains in economy resulting wholly from an improved atomization of the fuel, and with no heat supply in either case other than that carried by the room air at 67° F., two carbureters having identical air passages were fitted with two different types of spraying nozzles. That one having the better atomization of the fuel is designated *B* in the table following, and the other is designated *A*. Each of these carbureters was set to deliver the same B.H.P. at 1,200 r.p.m., which in the case of carbureter *A* was all that could be obtained. Carbureter *B*, at speeds below 1,200, uniformly pulled .1 to .2 B.H.P. more than did *A*. Their relative fuel consumptions in lbs. per B.H.P. per hour were as follows:

	700	800	900	1000	1100	1200
A	.725	.710	.732	.750	.750	.755
B	.681	.635	.625	.582	.555	.563
B/A	.94	.895	.85	.776	.74	.746

These speeds represent the normal range of running speeds of this motor in service, and the figures given are a most eloquent commentary on improved atomization as a means to economy of operation.

As far as we have gone in the foregoing, three points have been brought forward, namely: (1) That temperature variations in the carbureter disturb mixture proportions; (2) that heat supply must be made to secure a sufficient vaporization; and (3) that the necessary heat supply for vaporization can be greatly reduced with a proper atomization. The statement of another point, (4) that the more nearly vaporized the fuel at the time of ignition, the leaner the mixture that can be used to secure a given result or output, completes the list the writer desires to present.

It seems that there can be no question of the truth of the last statement. The writer has proven it to his own satisfaction a great many times. In a paper now on the records of the Society, describing certain kerosene experiments, and in which experimental demonstration of the truth of the above assertion is given, is found the following:

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"One of the things chiefly noted in the making of these runs was the fact that each mixture temperature, as representing a rate of heat input to the fuel, has its own sharply defined mixture proportion. Even a very slight change in proportion, either way from the best, will, if the temperature is maintained constant, cause a marked falling off in the output of the motor. And the converse is equally true."

Let us see how these four premises agree in the operation of a carburetting device. The fact that proportions are disturbed by changes of temperature does not fit in particularly well with the fact that heat must be supplied to secure a sufficient vaporization. If the second premise is acted upon, there are bound to be temperature variations in the carbureter. If heat is applied only after the mixture is clear of the carbureter, mixture proportions are not apt to be disturbed by it, as noted earlier.

But, is it then possible so to apply the heat as to secure rapid vaporization? The writer believes that it is at least much more difficult to do so. This belief is based on experimental evidence, which shows that of all portions of the intake passage, that immediately beyond the carbureter is most effective in securing vaporization. And the reasons are not far to seek: When the fuel leaves the jet it is subdivided more or less finely, and is entrained in the air in comparatively small portions, each distinct from the other. Thus, the ratio of its surface to its volume is great, and vaporization progresses rapidly. After the mixture has entered the distributing branches, but very little of the unvaporized fuel remains entrained, because of the effect of the bend or bends. The greater portion remaining unvaporized is in contact with walls, thus reducing the ratio of exposed surface to volume of liquid. After bends have been encountered, wall heating is therefore the most logical vaporizing expedient, but, for the reason stated, it can never be as effective as air heating, unless excessive temperatures are resorted to.

The third point, that atomization largely relieves the need for heating, seems to offer a measure of relief. But, as stated in the preceding paragraph, the time to apply the heat is while the fuel is entrained and suspended in the air-stream. And, of course, this argument applies with the greater force the more perfect the atomization, and, therefore, the entrainment.

The fourth statement, of the dependence of mixture proportion upon the degree of vaporization, clashes strongly with that on the effect of temperature change upon mixture proportions. As a result of increased carbureter temperature the mixture becomes enriched, when, in fact, it should become leaner, to fulfill the requiremnts of economical and satisfactory operation.

This is the way matters stand as a result of the gradual, but none the less sure, "let-down" in the quality of our motor fuel. Some relief of the situation lies with the carbureter makers, in the development of devices in which the rate of fuel discharge is more nearly independent of the temperature, and in which extreme atomization is made to take the place of the quite considerable carbureter heating that is now generally practiced in an effort to secure a workable degree of vaporization. That this

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latter must be secured is self-evident, in view of the universal demand for greater economy of operation.

The problem can be satisfied only by the closest co-operation between the carbureter maker and the motor car builder—which is a state of affairs as yet hardly thought of, except by the carbureter maker—and a campaign of education by the car builder, for the enlightenment of his owners.

Presented at Meeting of Metropolitan Section.

AUTOMOBILE GREASES

By W. Jones

In selecting a grease for use in the automobile, one that is the best suited to the purpose, it would seem that the automobile engineer has very little to guide him. It will perhaps be interesting to look over some of the greases that are on the market with a view of determining their relative value as lubricants.

All of the many greases now offered to the automobile engineer and which have come under the writer's observation, can be placed in about three main groups, the proportions of the various ingredients varying together with the quality and density of the oils used.

We find that these greases contain mineral oils, vaseline and resin oil, the latter being the most generally used and containing more or less resin. These are combined with carbonate of soda, lime, graphite, both natural and artificial, and wood chips. All these greases except those composed of straight vaseline and graphite contain more or less water. The vaseline greases melt at rather low temperatures, while those composed of heavy resin oils and lime, may require a temperature of over 200 deg. Fahrenheit for melting. To give some idea of the different makes of greases on the market I submit the following values for thirteen greases I have examined:

No. 1 is a rather stiff grease, which, however, melts at 107 deg. Fahrenheit. This is about the melting point of vaseline. This grease contains 0.75 per cent. of carbonate of soda.

No. 2 is a very much softer grease and contains 0.72 per cent. of carbonate of soda, but only partly melts at 200 deg. Fahrenheit.

No. 3 is a mixture of vaseline and natural graphite. It melts at 108 deg. Fahrenheit, and contains only 0.42 per cent. of ash, which comes from the graphite.

No. 4 is a similar mixture of vaseline and graphite and also contains about 25 per cent. of wood chips. Of course the last named have no lubricating value, and just what value they have in the grease is hard to say. The best that can be said is that in time they will be ground to pulp and prevent the flowing of the grease at temperatures above its melting point, which is low. The ash in this grease is only 0.25 per cent.

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No. 5 is a grease that melts only partially at 200 deg. Fahrenheit and has an ash of 2.40 per cent., which is lime.

No. 6 is a grease containing artificial graphite. It has a melting point of 200 deg. Fahrenheit and contains 1.95 per cent. ash, which is lime.

No. 7 is what is called a non-fluid oil. It melts at 170 deg. Fahrenheit and has ash of 3.70 per cent., which is a mixture of lime and carbonate of soda.

No. 8 has a melting point of 190 deg. Fahrenheit and contains 1.50 per cent. of lime as ash.

No. 9 has a melting point of 190 deg. Fahrenheit, the same as No. 8, but contains only one-half the amount of lime, 0.95 per cent.

No. 10 is another non-fluid oil, which melts above 200 deg. Fahrenheit and has an ash of 3 per cent., which is a mixture of lime and carbonate of soda.

No. 11 melts at 125 deg. Fahrenheit and has an ash of 0.85 per cent.

No. 12 is a semi-fluid black oil, at ordinary temperatures. This is an unmixed mineral oil, and has no ash.

No. 13 is the stiffest grease of the lot. It melts at 225 deg. Fahrenheit and has an ash of 6.95 per cent., all lime. This grease is made from a heavy resin oil, and contains a large amount of resin.

In considering the above data, we find we have to deal with mineral oil and vaseline, resin oil, resin, carbonate of soda and lime. The mineral oil and resin, carbonate of soda and lime have not much value in this connection. Therefore it would seem advisable to select a grease with as little of these ingredients as possible. If we want a heavy grease, one made of resin oil and lime, we should select one made from a good quality oil, containing little or no resin and low lime percentage.

On the other hand, if we can use a grease of low melting point, the mixture of vaseline and graphite should give good results. Here the amount of graphite may be increased to prevent too easy flowing of the grease at temperatures above its melting point. Either natural or artificial graphite may be used. Mixtures of lime thickened resin oil also give good results.

In deciding upon an automobile grease, it is first necessary to determine the temperature at which it is to be used, and then make proper mechanical tests of different compounds to determine which gives the best results. This, so far as the writer knows, has never been done. A formula for greases, to be used at different temperatures, that would give the least friction and heating, can be devised.

DISCUSSION

HERBERT CHASE:—Professor Jones gave the Section a considerable amount of time during a season when he was very busy, to make special analyses of over a dozen different samples of greases which were furnished him in order that he might have data on which to base this paper.

H. W. SLAUSON:—Was it specified in Professor Jones' paper that the

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greases which he examined were all mineral greases, or were some of them animal greases?

HERBERT CHASE:—Professor Jones did not find any trace of animal oils in the greases. There were a few vegetable oils, chiefly resin oils. I selected the greases out of a number of representative brands that can be purchased from almost any supply house.

M. R. MACHOL:—Supposing a grease is wanted for a place that will run fairly warm, what grease do you select? Do you select a grease with graphite in it, a grease made of animal oils, or vaseline? How are you to pick it out? If you want to use grease in a place where it will run cold, what kind of grease should you have there? That sort of information would be of very material assistance.

ACHESON SMITH:—I think that if anyone wants grease for any particular purpose, he should send the specifications to the grease manufacturer or anyone who is in a position to furnish the various kinds of grease, and let him fill the requirements.

The subject of greases is such a peculiar one that it would be impossible in the time at our disposal this evening to tell how they are all made and what affects the cold test, the melting point and various other things, in the case of various oils, as there are one hundred and one different combinations.

M. R. MACHOL:—What affects the cold test generally? Is vaseline a good thing? Is graphite in the grease a good thing?

A. SMITH:—I will answer directly in regard to vaseline grease. Vaseline is a pure mineral grease and melts at a low temperature, and also stiffens up in the cold very quickly, so that it has to be used within a reasonably narrow limit of temperature. As to the graphite, that would depend on the surface upon which it is to be put, whether you want it large or little, and also whether it is to be used under conditions of cold or heat.

R. McA. LLOYD:—I doubt if the grease manufacturers are able to provide special greases for special conditions, even if they know what is required. I think a good deal of the information has been acquired by pure accident, certain greases having been found satisfactory in certain cases. I doubt if much study has been given to the subject by the people from whom we are buying grease.

H. W. SLAUSON:—There is one point in Professor Jones' paper that I would like to refer to, and that is the proportion of ash, or in most cases lime, that was found. I understand that lime is not a good thing to have in large percentage in grease. I heard of one case in which lime proved harmful in a transmission. Lime incrustations were found on the gear teeth, which has so hardened that the shafts were thrown out of alignment.

H. E. HAWS—A certain amount of lime has to be used in making mineral greases to cause saponification. I do not know that lime is ever used in larger quantities than is necessary to do that, speaking, of course, of well made greases. In the case which has been cited, I wonder if it is certain that the substance deposited was lime.

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CHAIRMAN ANGLADA:—What might it have been, Mr. Haws?

H. E. HAWS:—I do not know. It is hard to say without seeing it. As far as mineral cup or transmission greases are concerned, I do not know of any that contain resin.

F. H. FLOYD:—Considering greases as lubricants is, I believe, largely a matter of studying working conditions. The manufacturer aims to make up various consistencies and qualities of grease to meet varying conditions, with the result that they have a great variety, all of them essential.

Greases are called "hard oils" by some. Oils have a certain viscosity or body and when they reach a certain limit of body are found unsuitable as lubricant under extremely heavy loads. The lubricating films break down and the metals abrade.

The grease manufacturer takes different oils and by saponification and otherwise breaks down the fat globules and produces a plastic substance that is a greater load sustainer than the heaviest oil. The value of grease, I repeat, depends largely on its consistency or load bearing value.

For ball bearings we want a lubricant that will not attack or corrode metals in any way. Something that will follow nicely the races, and properly lubricate the balls. Here we find that a certain consistency of grease is very essential. If it is too hard, it refuses to follow the balls, and they are improperly lubricated. If it is too soft, it flows away and leaves them dry.

Numerous other conditions require greases of different consistencies. The grease-maker in his processes will start from a very soft consistency, something perhaps that will just flow and will then increase the hardness, regulating the various consistencies by numbers. For example, he may call a grease of a very soft consistency No. 0, and others 0½, 1, 1½, 2, 3, 4, 5 and 6. There are no standards.

The grease manufacturer leaves the consumer to decide what consistency of grease he requires, although I think salesmen should be able to take up the working conditions and prescribe a grease for a particular purpose. This cannot be done by the office of the purchasing department.

There are places where soft greases are quite essential; or very adhesive greases, greases of a sticky nature, as, for example, in gear lubrication. An adhesive grease in gear lubrication prevents noise. It is a better load sustainer but the fluid friction of the grease is usually very much higher. This must be balanced. Greases of this character often have an asphalt base, yet they have their value.

As to resin oil in grease being undesirable, there are resin oil greases which are extremely valuable. Resin oil makes a very adhesive grease, which, as cited above, is a valuable property.

I repeat that we must take up working conditions and make up greases to meet them.

In referring to the stickiness of oils, we usually classify this under the head of viscosity. The animal, vegetable and hydrocarbon or mineral oils vary in this respect; some are lighter, some are heavier and some are more adhesive than others. When oils are converted into a grease, the

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load-sustaining power is dependent upon the way in which the manufacturer makes the grease up.

Let me state in a general way how the grease manufacturer proceeds in making up grease. What we term a boiled grease is made up in this way: Anywhere from fifteen to twenty-five per cent., usually of animal oil or vegetable oil or both, are saponified by an alkali, say a lime solution, with a hydrocarbon oil in suspense. Only the animal and vegetable oils are saponifiable, please bear in mind. You cannot saponify a hydrocarbon or mineral oil, but hydrocarbon or mineral oil is held in suspense in a grease by and with the assistance of saponified animal or vegetable oils.

The grease manufacturer gets the different consistencies largely by regulating the time of boiling; longer or shorter, getting softer or harder greases, depending upon what he wishes. He gets different melting points by this method, and, of course, load-sustaining value of the lubricant. This kind of grease is not, strictly speaking, a pure mineral grease. Vaseline is a pure mineral grease or hard oil. Then there are asphaltic products that are pure mineral.

As to animal or vegetable oils that enter into the manufacture of grease, there is no limit to the amount that you can add. Probably the greater the quantity of high-grade animal or vegetable oil that is used, the better a grease will be. But animal and vegetable oils are very expensive, while the hydrocarbon oils are very inexpensive.

H. W. SLAUSON:—Is there any animal or vegetable oil to which no petroleum or mineral oil has been added?

F. H. FLOYD:—I think possibly there are some. They are very high-priced, however, and may be used in the drug manufacturing establishments for lubricating special machinery and also for making ointments.

M. R. MACHOL:—Free from graphite?

F. H. FLOYD:—Graphite may, of course, be added to the grease. The purpose of adding graphite is to coat the metal or to fill up the low spots in it so as to get a perfectly smooth surface, even smoother than machining will make, consequently reducing friction. Graphite performs this function when added to a grease and assists the grease as a lubricant. It becomes a very valuable adjunct to the grease manufacturer in reducing friction, particularly in gear lubrication.

HERBERT CHASE:—I would say that lime is used only to saponify the fats.

F. H. FLOYD:—Yes, that is what it is used for unless perhaps to neutralize any free fatty acids that may be in the animal or vegetable oils. In the manufacture of grease we do not want an excess of lime or alkali of any kind, as it would injure the lubricating value of the grease. The grease-maker is desirous of a perfectly neutral grease, no acids or alkali in excess.

P. J. DASEY:—Is alkali used for the purification of the oil?

F. H. FLOYD:—It is used for saponifying and also to neutralize any acids that may be in the oils, whether they be free fatty acids or otherwise. In the matter of acids, about 85 per cent. of the oils on the market are treated with sulphuric acid and caustic soda solutions. This is not true

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of the filtered oils that come from Pennsylvania, however. The original process of treating hydrocarbon oils used in grease-making and those that come from the mid-continent fields, is treating them with sulphuric acids and alkali solutions and washing them with water to eliminate both. Still there may be traces of acid left and in the manufacture of greases an alkali will neutralize this.

Presented at Meeting of Metropolitan Section.

GRAPHITE AS A LUBRICANT FOR AUTOMOBILES AND BALL BEARINGS

By A. GALE THOMSON*
(Associate of the Society)

It is unfortunate that the average man is not more interested and better informed relative to the theories of lubrication. In technical schools this subject is one which the average student passes over as requiring little attention and as possessing more mystery than any other subject with which he has to deal. This is not only true of oils and greases in general, but especially true of graphite.

Graphite is a mineral and one of the natural forms of carbon. The origin of graphite is not definitely known, although it was probably formed by the distillation of vegetable matter.

Graphite varies in quality from that possessing but little lubricating value to that which is extremely valuable as a lubricant. Many conditions determine the commercial value of graphite, such as physical formation, ability to resist heat, unctuousness or lubricating quality. These determine the use to which any particular graphite is best suited.

Graphite enters directly or indirectly into practically every known manufactured product. The largest fields for the use of it are lubrication, the manufacture of crucibles, foundry facing, electrical apparatus, electrotyping, the manufacture of paints, pencils, stove polish, etc. A graphite which is suitable for one or more of these uses may not be suitable for any of the others, and this is an important point to remember. For instance, graphite for crucibles must consist of flakes which are heavy and tough and with surfaces that are fibrous or irregular to enable them to anchor in the binding material used.

Low grade or amorphous graphite is found in practically all countries. The cost of refining this grade is sufficiently high in many cases to prohibit economical working of deposits.

Graphite is also known as plumbago and black lead; plumbago being

*Sales manager, Joseph Dixon Crucible Company.

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the term used by custom officials with reference to the foreign grades, principally received from Ceylon, and the term black lead being applied to the cheaper or inferior grades.

There has been much opposition to the use of graphite as a lubricant. Not many years ago an American railroad company enacted a rule that engineers using graphite on its locomotives would be discharged. Today, however, this railroad purchases large quantities of flake graphite for lubricating purposes. The Delaware, Lackawanna & Western Railroad conducted experiments which proved that the use of a small amount of flake graphite in locomotive steam cylinders increased the efficiency of the locomotives to the extent of saving a great many thousand dollars per year in fuel.

When two metal surfaces are brought in contact, the minute irregularities interlock and act to retard motion. Lubricants are intended to reduce friction by preventing the actual contact of metallic surfaces, thus substituting the lower friction of the lubricant.

Oils and greases are the two best known reducers of friction, but flake graphite possesses qualities not shared by either oil or grease. In the first place, it overcomes in a measure the specific cause of the friction, the microscopic roughness, by filling in the depressions, forming a smooth, tough, veneer-like surface on the metals. The efficiency of oils and greases is much affected by varying conditions of temperature, pressure and velocity. The ideal condition is, of course, that in which the lubricant used has the least viscosity necessary to keep the rubbing surfaces apart, but in attempting this there is always danger that the varying conditions may reduce the viscosity to the point where the lubricant cannot support the load. This danger entirely disappears when flake graphite is used in connection with oil and grease, as metallic contact cannot occur when it is present.

Graphite exists in two forms: crystalline or flake, and amorphous. The distinguishing characteristic of graphite is its quality of unctuousness. All graphites have this quality more or less, the crystalline form being better in this respect than the amorphous, for the reason that when a graphite crystal is subdivided the cleavage surface is smooth, while with amorphous graphite the line of fracture is irregular and rough; only when these irregularities are worn away does the amorphous graphite become smooth.

A true lubricant has been described by some who advocate the suspension of graphite in oil as "a body that will subdivide so that all movement will be within itself and not between it and the adjacent metal"; also, that a perfect suspension of graphite and oil "is of a nature that permits of slipping within its own mass without any expenditure of energy that will produce high temperatures."

The definition of a true lubricant is an excellent one and perfectly describes a liquid or semi-liquid substance where the material adheres to both friction surfaces and where the particles of liquid are in constant movement one on the other. No stretch of imagination can enable us to conceive of such a condition when considering graphite, which is a solid

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substance, considerable force being required to separate its minute particles.

A mixture of graphite suspended in oil, as indicated above, has no particular advantage over a non-graphite oil as a lubricating material, because the particles of graphite, being in suspension, cannot break through the surrounding film of oil and become attached to the metal surfaces. They simply move about in the oil film without at all decreasing the viscosity of the oil, which is the only way any reduction of friction can be brought about. In fact, a mixture of finely divided graphite and oil has a higher viscosity than that of oil alone.

Taking the viewpoint that the individual particles of both oil and water are solid, and that the specific gravity of graphite is greater than that of water or a light oil, it will be necessary to have the particles of graphite very small in order to hold them in suspension in water or light oil. If the larger particles of oil or water will not keep the friction surfaces apart, how can the smaller particles of graphite be expected to perform this function?

In all friction surfaces, the irregularities are both above and below the normal surfaces. It is the irregularities above the normal surfaces that cause friction. It is important that whatever surfacing material is used should be able to build up the surfaces to the level of the high points rather than to simply fill up the minute pores of the metal. It is not conceivable that any particle of graphite small enough to go through a filter paper could become impaled on one of these projecting peaks, but such a result is entirely possible where broad flake graphite is used. Everyone knows how difficult it is to sweep up a small, flat piece of paper, like confetti. The same reasons that cause the paper to adhere to the floor cause the graphite flakes to adhere to the surfaces which it is intended they shall lubricate.

A chemical analysis is not the best test for flake graphite that is to be used as a lubricant, because when it is burned a residue of mica is left after all of the graphite carbon has been consumed, and experience has shown that this mica material left as an ash does not detract from the lubricating value of the graphite. Structure, size of particles, cohesiveness, character of impurity and other physical properties bear the real important relation to lubricating value, not mere high percentage of carbon.

In some tests conducted by Professor Goss, using both amorphous and flake graphite with kerosene as a carrier, the latter was proven superior. When kerosene alone was used as a lubricant, with a pressure of 50 pounds to the square inch, the addition of amorphous graphite did not permit the load to be increased, although the friction was reduced about 20 per cent. When flake graphite was used with the oil, the load was increased to 120 pounds per square inch and the friction reduced almost 50 per cent.

I want to emphasize that I do not recommend graphite as a competing product with oils and greases, but rather as a substance which increases their lubricating properties. The lubrication of ball and roller bearings

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on semaphores of railway signal systems is interesting in this connection, in that they are lubricated with dry flake graphite alone, no oil or grease being used. Professor Goss conducted some elaborate experiments with graphite as a lubricant for ball bearings. His conclusions are as follows: "A combination of graphite and lard oil makes up a lubricating mixture which, when applied to ball bearings, will accomplish everything which lard and oil will do and which at the same time will give a lower frictional resistance of the bearings and permit a large increase in the load which it may be made to carry. An oil or light kerosene, when intermixed with graphite, will be converted into an effective lubricant for ball bearings when operated under light or medium pressure. Even so viscous a lubricant as vaseline will better perform a given service in the lubrication of ball bearings when supplemented by small amounts of graphite. The bearing to which the mixture is applied will work with less frictional resistance and will carry a heavier load than when vaseline is used. The admixture of graphite with either a liquid or viscous lubricant serves both to reduce the friction and to increase the possible load which a bearing thus lubricated can be made to carry."

Almost every engineer is ready to admit that for plain bearings graphite alone or combined with the proper carrier is very satisfactory, but takes the stand that it is not so well adapted to ball or roller bearings. I have heard many engineers state that graphite will pack in the ball races, obstruct the balls, and spread the races and containers. This is true of amorphous graphite, but not of flake graphite, because when the latter is broken the cleavage surfaces are smooth.

All graphite is not lubricating graphite, nor is all lubricating graphite fit for automobile lubrication. Referring to motor lubrication, a percentage of graphite mixed with oil will increase compression, eliminate friction, and cause a considerable saving in oil. Most of the oil that is used is consumed in the explosion chamber. If you increase the compression less oil will get past the pistons and rings into the combustion chamber.

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Presented at Meeting of Metropolitan Section.

DEFLOCCULATED GRAPHITE AS A MOTOR LUBRICANT

By MARCUS A. SMITH*
(Associate of the Society)

In 1906, in an electric furnace designed by Dr. Edward G. Acheson, the manufacture of unctuous artificial graphite was commenced. The material used to make this graphite is a carefully selected form of natural carbon. The electrical energy employed approximates 32,000 K.W. hours per furnace. The temperature created is slightly over 7,500 deg. Fahrenheit, the highest temperature used in any commercial furnace work in the world.

Shortly after graphite was manufactured for commercial purposes, Dr. Acheson commenced a series of experiments to determine the possibility of subdividing graphite to such a small state that it could be used in lubricating oils without settling. He found that the action of certain liquids on particles of graphite, would cause them to separate into small subdivisions, and then again cause these subdivisions, or particles, to continue to subdivide until the graphite reached the colloidal state. This substance he named deflocculated graphite, because flocculation is the union of small particles into granular aggregates or compound particles of larger size. Having reduced graphite to this colloidal form it was found that added to oil or water it remained in suspension, owing to the fact that the law of gravity does not affect matter in the colloidal state.

The lubricating value of an oil is dependent upon its successful maintenance of a proper oil film between the moving surfaces, and the amount of internal friction in the oil itself. By adding to the lubricating oil one-quarter of one per cent. of deflocculated graphite it is possible to carry to all surfaces a material that is finer than the most minute pores of the metal and which will gradually saturate the metal with a lubricant that heat cannot destroy. The benefits derived from the use of deflocculated graphite diffused in oil are accumulative, for with continued use all the bearings, cylinder walls and piston rings are protected by a lubricant which impregnates the metal. If at any time the supply of lubricant is shut off, the coefficient of friction remains practically the same for many hours; this fact has been proven by numerous experiments, one of which is of special interest. Professor Charles F. Maybery conducted a series of tests using one of the best automobile lubricants alone and then charged with colloidal graphite to determine the coefficients of friction. The bearings were of hard babbit metal. Using an oil feed of eight drops per

*Lubrication Engineer, International Acheson Graphite Company.

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minute, with a pressure on the bearing of 200 lbs. per square inch, at 450 r.p.m., the coefficient of friction remained constant for a period of two hours. The oil supply was then shut off and the oil film broke in 17 minutes. Under the same conditions, but with colloidal graphite and oil, the coefficient of friction for two hours' running was much lower, and when the oil supply was shut off continued at practically the same point for five hours, at which time the test was discontinued. Professor Mabery determined that it was possible to decrease the supply of lubricant when charged with colloidal graphite to one drop in two minutes, and still have the coefficient of friction remain constant.

By using deflocculated graphite diffused in oil in place of plain oil in assembling the motor and then in the lubricating system when it is belted in and when it is run under its own power on the testing stand, and again while on road test, it is actually possible to secure more perfectly seated bearings, freer action of piston rings, better compression and a lower consumption of fuel and oil, with resultant lessening of carbon troubles. When the graphitoid surface is created it is, in reality, an anti-friction metal formed right where needed.

The writer has in his possession much data collected as a result of tests of many well-known motors. These tests were made in the shops or dynamometer rooms of the several companies, and always in conjunction with the engineers. One concern manufacturing 20,000 cars per year tested 97 motors (48 with plain oil and 49 with deflocculated graphite), and showed a time saving of 26.6 per cent.

Another interesting test was completed recently for a concern having an output of 40,000 cars per year, in which a large number of motors were taken from the final assembly and run in, some with deflocculated graphite and some with plain oil. Readings of torque, compression, etc., were taken as soon as each motor had been mounted on the dynamometer platform. Other readings were taken at periods measured in total revolutions, the r.p.m., temperature of water outlet and other conditions being similar during all tests. The dynamometer was of the well-known electrical cradle type.

Compression was plotted with reference to pounds per square inch and total revolutions. The curves showed that the motors using deflocculated graphite had a greater compression at the start, which increased gradually, and ended at a higher point than at the start, which was about 6 per cent. above where the plain oil motor curves ended. The torque chart showed that the deflocculated graphite motors from the start, during the run and at the end had much less internal friction than the plain oil motors. A time saving of 12.6 per cent. in total revolutions was made. When the motors were torn down and the cylinders, pistons, rings, etc., examined, it was judged that the surfaces of the deflocculated graphite motors were much superior to those of the plain oil motors. Throughout the tests the same standards of judging when motors were properly run in were used as are daily in vogue in the plant, the idea being to obtain results that would be applicable to general factory conditions.

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Deflocculated graphite applies equally well to the lubrication of transmissions, differentials, universal joints, worm gears, and such other moving parts in the modern automobile which require lubrication.

DISCUSSION

A. G. THOMSON:—I would substantiate everything that Mr. Smith said, except one remark. He said that graphite does not put a film or a veneer on the surface. I do not know much about deflocculated graphite, but I do know about flake graphite. It will fill in the pores, after which it places a veneer over the entire body, as much as the metal will hold.

P. J. DASEY:—After the surface is thoroughly veneered, what becomes of the rest of the graphite fed in the lubricating oil?

A. G. THOMSON:—Flake graphite will not adhere to itself by any known means and hence it is impossible to develop the veneer beyond a definite thickness.

L. G. BUSBY:—I would like to ask Mr. Smith and Mr. Thomson what effect graphite has on connecting-rod bearings? If lubrication failed, would the bearings of a motor in which graphite is used run longer before failure than those in a motor using no graphite?

A. G. THOMSON:—As long as you have the graphite veneer the metal cannot heat and for that reason it cannot wear. The proper kind of graphite, properly applied, will absolutely prevent the wear of metal, for the simple reason that you have a graphite to graphite contact and not a metal to metal contact. I think it is obvious that if the metal does not come in contact, it cannot wear.

M. A. SMITH:—The gentleman asked what would happen to the crankshaft bearings. If it is a new motor you must wear the bearing in some. If it is an old motor, which has been running some time, you must have a pretty good fit. We had a motor running on the dynamometer stand, and took out all the oil it was possible to get out, drained it completely, and ran this motor, which had previously been run in with deflocculated graphite. The motor ran several hours. We did everything we could to make it stop, raised the number of revolutions, put a load on the dynamometer and ran without water. We did not seem to be able to wear it out and had to stop it.

A. G. THOMSON:—I think I can give an illustration. I once accidently knocked a hole in the crank case of an engine, and in the emergency stuffed up the hole with the sleeve of a leather coat. Having no oil I mixed one-half pound of motor graphite with a bucket of water and poured the mixture into the crank case. The engine was in as good condition at the end of 70 miles as before, so far as I could see.

L. G. BUSBY:—Do you recommend charging the motor only occasionally with graphite?

A. G. THOMSON:—I believe it is customary to recommend using a certain amount of deflocculated graphite with each five gallons of oil. We recommend a scant teaspoonful of flake graphite to a gallon of oil.

I know a man who has been running a Packard car for something like

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five years. Once a year he takes the motor down, and after cleaning it and draining out all the old oil and graphite, puts in the crank case a half pound of motor graphite to each cylinder, two pounds of graphite, and does not touch the motor for a year. I do not recommend this practice, but he ran that way for five years. He never put in a new rod or ring or had a valve ground. I know of another case in a recent race, where a pound of graphite was used to fill in the scores in badly scored cylinders and pistons. The car won the race.

There was a time some years ago when graphite was not advocated for use in engines, because of spark trouble, but the ignition has been improved to such an extent that we never hear of that trouble today with modern engines. The quantity of graphite to be used, and the method of using it have a good deal to do with the matter. We are operating several cars at our factory. A quarter of a pound of graphite is put into each crank case every three months. We find that serves the purpose admirably.

M. A. SMITH:—Deflocculated graphite is used continuously, not intermittently. It does not settle in the oil, and it is not necessary to put it in according to periods measured by months or days.

B. M. BESKOW:—I made a test of a motor in which oil and deflocculated graphite had been used, and I found it was coated with a film of graphite. Would that surface cause a short circuit?

M. A. SMITH:—In the case of graphite which is in oil in a deflocculated condition, you cannot get a current through the material in a liquid form.

We have had tests of Ford cars on which the magneto runs in an oil bath, the oil being charged with deflocculated graphite. The oil does not short-circuit the magneto. You understand that cylinder oils are composed of about 20 per cent. hydrogen and 80 per cent. carbon. The weight of a gallon of oil is about 7.5 lbs. The weight of the 80 per cent. of carbon is about 5.8 lbs., the actual carbon in the oil, a good lubricating oil. It stands to reason that if we add but one-quarter of one per cent. of graphite to the oil, the amount of graphite which passes the piston rings to the combustion chamber and is burned up, or incompletely burned up, is comparatively small, as compared to the carbon of the oil itself. The trouble which people have with spark plugs is from the carbon that comes from the oil.

P. J. DASEY:—I ask these gentlemen whether they are prepared to go into a factory, and actually demonstrate, under actual working conditions, these different problems. I have heard a lot about dynamometers and all that. The fact of the matter is that the thing that tells the story is to go into the factory under general working conditions, where there is not all of the paraphernalia involved in dynamometer tests, etc., to bother with. Can the same showings be made under those conditions, and can we have some test figures made under those conditions?

A. G. THOMSON:—Would you be willing to make these tests?

P. J. DASEY:—If I had time I certainly would be glad to make them. Have these tests been made?

A. G. THOMSON:—I cannot answer that question the way you want it answered. If bearings and pinions are proper, not too hard and not too

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soft, normal in other words, we will guarantee to reduce friction in the operation of the car and prevent the wearing of metals. Taking a 30-h.p. car as a basis, we will undertake to give you a guarantee of at least one more mile of travel to each gallon of gasoline consumed. We will become responsible for the car.

P. J. DASEY:—Is it engine cylinder lubrication?

A. G. THOMSON:—Entirely thoughout the car.

P. J. DASEY:—I would like to see tests conducted similarly to that and others that would give us an idea as to the comparison between the values of the two lubricants.

A. G. THOMSON:—We would be glad to undertake them if some of you gentlemen will work them out. We have lots of such figures, but it would be very agreeable to us to have someone here make some tests.

M. A. SMITH:—We are willing to go into an automobile factory and make tests under working conditions, proving the matter theoretically and practically.

H. W. SLAUSON:—If a man had failed previously to use graphite in the cylinders, and wanted to make up for lost time, in order to prolong the life of the motor, could he do that all at once by any process of dusting the graphite on the cylinder walls and bearings and wiping it off? Would that take the place of charging the crankcase?

A. G. THOMSON:—The best way to assemble any motor is to rub the the graphite into all the working parts, to get it there and know it is there.

H. W. SLAUSON:—Wipe off the excess?

A. G. THOMSON:—No, that is not necessary if you use proper graphite. But all graphite will wear away in time. The flake graphite will last much longer than amorphous graphite under any stress. If you will carry in your crankcase a small amount of graphite to supply that which is worn away, you will have permanent lasting results.

L. P. PROSSEN:—It was stated that graphite contains a certain amount of mica. I would ask as to what extent graphite is affected by the mica, and whether there would be any destructive effect on the working surface of the motor caused by it.

A. G. THOMSON:—Mica is not a lubricant. In all flake graphite you will find a small percentage of mica, which is not a detriment to it, nor will it injure your bearings in any way. The graphites I speak of will vary from 1 to 2.5 per cent. in mica content.

P. J. DASEY:—Is there any liability of the graphite getting into the oil circulating system, or stopping up the holes in the bearings?

A. G. THOMSON:—Any graphite will settle in oil in time. If you keep it in suspension it will not increase the lubricating qualities of the oil.

P. J. DASEY:—Do you have a graphite that remains in suspension?

A. G. THOMSON:—No, sir, we have not. You cannot subdivide graphite infinitely and retain its lubricating properties.

P. J. DASEY:—In this other case they must subdivide to a great extent, but still the diagrams showed better lubricating quality than we have with the oil itself. How does that match up with your statement?

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A. G. THOMSON:—It matches up very well. You get more efficient lubrication from the use of any graphite, unless it is so poor it will cut and destroy the bearings, but you will not get the lasting results from the amorphous graphite that you will from the flake graphite. It is more friable and wears away. It does not put a film over the material, but only fills the pores.

M. A. SMITH:—We found that deflocculated graphite mixed with an oil will stay in suspension for an indefinite period; in fact, we have had it in suspension for years. We find, however, that where the oils have been made by an acid process, some oils have such a percentage of acid that it acts on the graphite, tending to reverse the principle of deflocculation.

F. H. FLOYD:—As to the use of graphite in grease, its advantages are that it does not settle out in the grease owing to the plastic condition of this lubricant. It will remain in suspense and more thoroughly coat the metals or fill up the low spots, than it will in an oil. By filling up the interstices we get a perfectly smooth metal, and since there are no high spots we prevent abrasion and consequently wear and friction.

As far as the use of graphite in grease is concerned, there are very rare places where it is not an advantage when properly used. It has a tendency to make grease more brittle. The addition of the right amount of graphite, of course, I have always considered to be an advantage as a load sustainer. In the lubrication of all kinds of gears under heavy loads the use of flake graphite in proper proportions is an advantage.

When it comes to the use of graphite in oil, that is a different proposition. If it could be held in suspension perfectly so that it could be shipped commercially throughout the country and remain in suspension, I believe it would be advantageous to use if fed uniformly, but because of the difference in weight between graphite and oil, graphite being very much heavier, it has a tendency to settle to the bottom of the receptacle. With the average individual likely to fail to take the precaution to stir the graphite and oil, and to get an oversupply, I think it has been largely objectionable. If it could be transmitted to the metal uniformly, in the oil, I think it would be an advantage.

Up to the present time, I have never been able to find any graphite that could be held perfectly in suspense for a long period. For that reason I have never dared to use it in oils or recommend it.

M. A. SMITH:—There were probably periods in our first work when we were not quite familiar with the carrying material, and it is quite likely that we have made some errors in our previous processes, but today I am willing to have Mr. Floyd put his oil in a tube, and I will put the deflocculated graphite in the oil, and we will keep it in a state of suspension.

A. W. TAYLOR:—Does not Dr. Acheson say that whenever there is any acid present at all there is a tendency to precipitate?

M. A. SMITH:—He says that because he is a scientist.

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CHANGE OF ADDRESS OF S. A. E. MEMBERS.

Baldwin, A. S., formerly general manager Alberger Pump and Condenser Co., Newburgh, N. Y., now manager of works, Best Mfg. Co., Pittsburgh, Pa.

Bate, John W., formerly president and general manager Racine Auto Parts Co., Racine, Wis., now first vice-president and general factory manager, Mitchell-Lewis Motor Co., Racine, Wis.

Brown, Lewis B., formerly vice-president, Aristos Company, New York City, now with Lee, Higginson & Co., New York City.

Carrell, Wm. A., formerly tool room foreman, Wisconsin Motor Mfg. Co., Milwaukee, Wis., now superintendent, Beaver Mfg. Co., Milwaukee, Wis.

Dean, Peter Paul, formerly manager of New York Branch Ingersoll Rand Co., New York City, now branch manager, Chevrolet Motor Co. of New York, Inc., New York City.

Duryea, Chas. E., formerly president, Duryea Motor Co., Saginaw, Mich., now with Cresson-Morris Co., Philadelphia, Pa.

McMahon, H. R., formerly vice-president, Liggett Spring & Axle Co., Pittsburgh, Pa., now with Standard Steel Spring Co., Pittsburgh, Pa.

Manson, Ray H., formerly secretary and chief engineer, Dean Electric Co., Elyria, Ohio, now with Garford Mfg. Co., Elyria, Ohio.

Moskovics, F. E., formerly secretary, Jones Electric Starter Co., Chicago, Ill., now with Nordyke & Marmon, Indianapolis, Ind.

Schermond, Wm. C., formerly assistant to chief draftsman, Vaughan Motor Car Co., Inc., Kingston, N. Y., now with Geo. M. Jagers Mfg. Co., Racine, Wis.

Teetor, Ralph R., formerly mechanical engineer, Light Inspection Car Co., Hagerstown, Ind., now mechanical engineer, Teetor-Hartley Motor Co., Hagerstown, Ind.

POSITIONS AVAILABLE

The following announcements are published for the information of members of the Society. No charge whatever is made for these announcements. Members who wish additional information will please address the office of the Society:

55. Tool draftsmen. Men experienced on motor design.

123. Production manager or production superintendent. Man who can reduce costs and get out quantities.

127. Salesman for heavy trucks on a commission basis. Not necessary to give entire time.

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128. Wanted to correspond with a steel foundry molding expert, who is an authority on the positive proper layout of patterns in flasks, the placement of heads, gates and risers to insure the maximum percentage of good castings. Object, temporary engagement only in localizing difficulties and causes of castings failure.

130. Manager for foundry making automobile engine castings, aluminum brass and iron departments. Must be experienced in this line. Full information as to past experience and references should be furnished with first letter. Location middle west.

133. Young man, bright and one who has had some training; also practical experience in motor assembling.

135. Sales manager, salary and commission to be agreed upon.

136. New metal-making and electrical machinery designer. To improve good machines and tools now in use. Broad and practical knowledge of electricity, electrical machinery and power plants, necessary. Must be able to investigate any mechanical proposition, and secure best efforts of men. College graduate preferred. Knowledge of construction of motor-driven vehicles desirable. Employing company one of the largest in its field. Located in one of largest cities of Middle West.

137. Magneto designer to design special type of magneto; preferably in part time or evening work.

138. Production Manager. Must be able to handle large production of small cars. Good judge of men and handling of them. Give full particulars, references, and state experience fully or no attention given.

139. A high-grade man to sell metal working machine tools in the middle west; preferably a man with a technical education and good shop training with modern equipment. State experience and give references.

140. Assistant to general superintendent. A man thoroughly up on modern production methods.

141. Good detail draftsman for truck work. Must be quick and accurate. Give details of training and experience. Salary $20 per week.

142. Young man familiar with machine design. Experience on presses and shears preferred. Salary dependent on experience.

143. Assistant electrical engineer wanted by an established manufacturer of ignition apparatus. Not necessary to be an ignition expert, but a technology graduate who has taken an electrical course, preferred. Work to be mostly research and invention. State salary and give experience.

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145. Factory manager or general superintendent for a large machine specialty manufacturing company. Must be a master mechanic, mechanical engineer, with wide experience in manufacturing a large variety of small machine parts. State age and salary expected.

146. General Manager. A young experienced manufacturer for an established Massachusetts corporation making pressed steel parts and employing about 200 men.

147. Sales manager, experienced on commercial work and in position to invest $2,000. Exceptional opportunity.

148. First-class foundry superintendent, familiar with producing automobile castings in gray iron, aluminum and brass, in quantities. with the least possible foundry loss. None but experienced men need apply.

150. Good corresponding clerk for sales department of automobile accessory manufacturer. Give salary and experience.

151. Salesman to handle special steels in New England. Must be technically trained and have had practical experience in machining and heat treating of steels.

155. Good man to take charge of assembling and get stuff through in a large business in cyclecars.

156. Experienced draftsman.

157. Young man of technical and broad education to go to England for one or two years to become acquainted with business of high-class firm exporting to America, with a view to taking position in same connection in this country. Extensive practical experience not necessary. Moderate pay.

158. Draftsmen, with experience in designing small motors or generators for automobiles. For factory manufacturing small interchangeable parts for electrical apparatus. Only those having had at least three to four years' experience need apply. Salary $18 to $22.

159. Designer of successful special machine tools for multiple coincident operations, to design various machines for rapid production of small vehicle parts. Should have factory production experience.

160. Large stable manufacturing company wants man, for sales executive position, whose record warrants immediate assumption of large possibilities; man widely experienced in modern organization and having accurate appreciation of advertising value, as well as broad commercial insight. Experience in the automobile industry is not essential.

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161. Manager for service, parts division and garage of large corporation. Must have excellent engineering and executive ability, besides broad experience in this particular line of work.

162. Sales manager to superintend sale of automobile accessories. Must have experience in handling mechanical devices, and personal acquaintance with the trade.

163. Practical automobile engineer who has had experience in manufacturing a low-priced automobile and is familiar with costs, etc., and able to equip and manage the factory.

164. Clever young draftsman who can be depended upon to take care of finished detail work on bodies, windshields, tire irons, etc.

165. Engineer with executive and mechanical engineering ability to take complete charge of truck branch of million dollar concern. Technical graduate preferred. Liberal salary to right man. Exceptional opportunity.

166. Salesmen. Direct representatives calling upon automobile and other manufacturing trade with a mechanical specialty. Young men with technical or practical shop experience preferred.

167. Salesman, one that is capable of managing sales department, familiar with the automobile trade and of pleasing personality.

MEN AVAILABLE

017. Executive engineer.

025. Consulting engineer can render intermittent service on manufacture or marketing of commercial cars.

026. Engineer of wide experience, designing and consulting.

034. Consulting automobile engineer.

035 Consulting automobile engineer; gasoline or electric work.

082 Designing engineer, graduate of Massachusetts Institute of Technology, with considerable experimental, factory and designing experience on pleasure cars and trucks. New England preferred.

0180. Competent motor car engineer with five years' experience in both pleasure and commercial car work, is open for engagement as chief, assistant chief, designing or experimental research engineer. Has been connected with the best motor companies and is thoroughly familiar with the manufacturing and production ends of the business. Prefer Detroit or vicinity.

0183. A wellknown consulting engineer in London, England, having representation in America, is open to negotiate manufacturing rights, and to supply all the latest information about European practice.

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0196. Graduate mechanical engineer. Has had experience as designer, checker and chief draftsman for past five years with two of the largest companies in this country, making pleasure and commercial vehicles. Wishes position as chief draftsman or assistant engineer.

0198. Position as factory manager or general superintendent.

0200. Designing engineer and purchasing agent. Technical education and eleven years' practical experience in designing and purchasing, pleasure cars, and trucks from 750 pounds to 3 tons. Connected with large concerns in Detroit. Have several up-to-date designs completed to offer. References gladly given.

0201. Engineer capable of managing works, developing carbureting devices for both kerosene and gasoline, and testing generally. Can handle men and get results.

0207. Young engineer with extensive experience in designing, testing and research work on motor trucks. Capable of holding a responsible position.

0209. Designing engineer and superintendent having had seven years' experience on pleasure cars and trucks.

0210. Young technical graduate with experience in experimental work and drafting desires position in West.

0213. Engineer, experienced in truck and pleasure car design and shop practice, expert designer of special equipment for interchangeable manufacture, open for engagement as superintendent or chief engineer.

0214. Mechanical engineer at present in charge of the designing and engineering end of a well-known truck manufacturing concern desires position as designer, chief draftsman or engineer. Age thirty-four. Eleven years' experience. First-class references.

0215. Engineer, technical graduate, experienced in design of electric pleasure cars and commercial electric trucks, at present in charge of engineering and designing department of one of the most prominent electric commercial vehicle manufacturers, capable of taking entire charge of engineering and designing department of company manufacturing electric commercial and pleasure cars.

0217. Member, mechanical engineer, Massachusetts Institute of Technology, now holding position as engineer and factory manager, desires change to position where there are greater opportunities. Fourteen years' experience in automobile industry, successfully holding positions as designing engineer of pleasure cars and trucks, and various factory positions up to and including manager of factory employing eighteen hundred men. Have served present employer eleven years. Good executive, with ability to reduce cost of design and manufacture.

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0218. Foreign manager—six years with last company. Well-known in automobile trade, American as well as foreign.

0219. Would like to secure agency for approved or desirable specialties, parts or material for introduction to manufacturers. My experience and acquaintance are such as to assure results.

0220. Member with a strong acquaintance and record would like position as sales manager or salesman for first-class line of parts, material or accessories for manufacturers of automobiles or allied products. Has strong personality and been notably successful with lines that require unusual ability to introduce.

0223. A well known sales engineer, who has for eight years successfully handled a prominent imported annular ball bearing, contemplates going into business for himself. Having secured the American agency for a well-known imported ball bearing, and an imported shock absorber of considerable merit, desires to arrange with some one who will furnish capital to the extent of $7,500 cash to be used in defraying the incidental expenses in promoting sales during the first twelve months. Banking connections have been arranged for financing the merchandise accounts.

0228. Shop manager, superintendent or purchasing agent. Young man of thorough business and technical training. Experienced in gasoline motor design, building construction and petroleum refinery work.

0229. Automobile designer, at present assistant chief engineer of a prominent concern desires to make a change. Twelve years' experience in automobile design and construction.

0231. Works manager, active technical man, thirty-seven years of age, designer and producer. Fourteen years' experience making high-grade interchangeable parts, special machinery, ordnance, etc. Available March first.

0232. Designer of several successful trucks desires position as chief draftsman, assistant engineer or chief engineer with a progressive truck company. Technical graduate. Married. Salary moderate.

0234. Designing engineer connected with one of the most successful Detroit automobile concerns. Twelve years' experience; motor specialist; good executive. Wishes position as chief engineer, assistant chief engineer or designing engineer.

0235. Engineer with eight years' experience designing and developing automobiles, commercial and cycle motors, desires position as assistant engineer, chief draftsman or designer. Vicinity of New York City preferred.

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0236. Draftsman wishes position. Five years' experience on gasoline motors, gasoline pleasure cars and electric pleasure and commercial vehicles.

0237. Position desired as works manager, superintendent or chief inspector. Have handled men for twelve years. Experience covers period of twenty-two years, both large and small machinery, including printing presses, typewriters, conveying machinery and ball, roller and thrust bearings. Experience in organizing and directing inspection departments. At present employed.

0238. Graduate electrical engineer. Nine years with present employer, a well-known pioneer motor truck manufacturer, holding positions as designing and production engineer, factory manager, and branch manager in charge of sales through western New York and Pennsylvania. Able executive.

0239. Sales electrical and mechanical engineer, with some years of civil engineering. Experience in both Europe and this country. Factory management generally. Strongest possible references for executive ability. Strong personality. Available March 1st. Canadian ready to take up duties in any part of world for strong organization.

0240. Position as designer or producer by a practical man. Fourteen years' experience on medium-priced pleasure cars. Location, middle west.

0241. Engineer, making an inspection tour through the leading British and French automobile works, offers an opportunity to American manufacturers to avail themselves of a report on latest foreign design and manufacturing practice.

0242. Position wanted as special representative in the Detroit field among automobile manufacturers.

0243. Position as superintendent, factory manager, chief engineer or chief inspector. Twenty years' experience in designing and supervising the construction of stationary and marine gasoline motors and complete automobiles.

0244. Designing or efficiency engineer for pleasure or heavy truck work. Will not consider light or cyclecar work. Have made a special study for the past three years of cars and their requirements in California and western territory.

0245. Executive engineer or superintendent with nine years' experience in the design and production of gas engines and automobiles. Technical graduate.

0246. Understanding thoroughly all branches of the automobile business, am willing to prove my ability. Nine years' manufacturing experience. Was general manager of one company for seven years.

0247. Technical graduate desires position as assistant engineer or service manager with automobile concern. At present holding responsible position in service department. Purely personal reasons for change.

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0248. Assistant to president, general manager or works manager of automobile parts plant. Four and one half years as superintendent of large ordnance and automobile parts plant, employing from eight to twelve hundred hands. Three years general manager of large engineering plant, manager steam turbines and all types of condensing equipment. Open for engagement April 1st.

0249. General manager open for an executive position of responsibility in manufacturing lines, which will afford an opportunity for substantial investment later if mutually agreeable. Detroit or vicinity preferred.

0250. Young mechanical engineer, Cornell University graduate, with three years' experience, embracing experimental laboratory and testing, designing and executive positions.

0251. Engineer with exceptional experience in small high-efficiency motors, both fours and sixes. Practical manufacture as well as technical.

0252. Young man with seven years' experience in automobile business in both factory and office end, would like to secure a position with a concern marketing pleasure cars, in either experimental or inspection departments.

0253. Position desired as production engineer or mechanical engineer on manufacturing equipment. Connected seven years with most successful automobile concern in the world. Now connected with leading automobile company. Experience along lines of manufacturing cost reducing. Good executive.

0254. Position in either engineering or testing work. Considerable experience in testing work and design of testing apparatus.

0255. Service engineer, carburetion especially. Twelve years' experience in motor car troubles. Would like position as assistant manager of service department, taking the practical detail work.

0256. Well and favorably known in automobile trade. Last five years sales manager prominent parts manufacturer. American speaking French, German and some Spanish. Prefer connection with good automobile company as export manager and foreign representative or salesmanager of first-class accessory or parts manufacturer.

0257. Member, formerly employed in design and layout of motor trucks, technically educated, with several years' experience in both shop and engineering departments of pleasure cars, trucks and adding machines, seeks a position in department of some good firm to sell trucks, cars or parts. Have selling ability and am a good correspondent with determination and experience to succeed in any work undertaken. Salary to be based on selling ability. Will accept temporary work in engineering lines with idea of getting into selling end later

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OFFICERS OF THE SOCIETY

President, Henry M. Leland, Detroit, Michigan.

Vice-president, William Guy Wall, Indianapolis, Indiana.

Vice-president, K. W. Zimmerschied, Detroit, Michigan.

Treasurer, Hermann F. Cuntz, New York.

Chairman of Finance Committee, H. M. Swetland, New York.

Secretary and General Manager, Coker F. Clarkson, New York.

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William Guy Wall, Indianapolis, Ind.

K. W. Zimmerschied, Detroit, Mich.

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E. T. Birdsall.....Chairman.
C. E. Cox and C. T. Myers.....Vice-chairmen.
Herbert L. Connell.....Secretary and Treasurer.

(Address) 109 Webb Avenue, Detroit, Mich.

Meets first Thursday each month at 8 p. m., in the Employers' Association Rooms, Stevens Building, Detroit, Mich.

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George A. Weidely.....Vice-Chairman
John G. Wood.....Treasurer.
Chas. P. Grimes.....Secretary.

(Address) Wheeler & Schebler, Indianapolis, Ind.

Meets first Tuesday after first Wednesday each month at 8 p. m., at the Hoosier Motor Club in the Claypool Hotel, Indianapolis, Ind.

METROPOLITAN SECTION

Joseph A. Anglada.....Chairman.
Herbert Chase .....Treasurer.
N. B. Pope.....Secretary.

(Address) 1790 Broadway, New York City.

Meets last Thursday each month, except July and August, 8 p. m. 1790 Broadway, or Automobile Club of America, 247 West Fifty-fourth Street, New York City.

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Members are requested to advise the S. A. E. office promptly of change of address, using form herewith:

SECRETARY,

SOCIETY OF AUTOMOBILE ENGINEERS,

1790 Broadway, New York City.

Please change my address now appearing on your records, to the following:

Company connected with.....

Profession or Position.....

Address of Company.....

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Articles Manufactured.....

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Very truly yours,

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S. A. E. Member.

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SECRETARY,

SOCIETY OF AUTOMOBILE ENGINEERS,

1790 BROADWAY, NEW YORK CITY.

DEAR SIR:—

We are manufacturing the following articles in compliance with the standards and recommended practices accepted by the S. A. E.:

Article	*Carried in Stock*
.....	.....
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Very truly yours,

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COMPANY

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1790 BROADWAY, NEW YORK CITY.

Please send application blank to

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whom I consider eligible to S.A.E. membership.

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Engineering Library

Summer Meeting Program

S. A. E. BULLETIN

Vol. VI **May, 1914** **No. 2**

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HEADQUARTERS JUNE 23-26

HOTEL CAPE MAY

MAKE YOUR RESERVATIONS EARLY

Issued to Members
by the

SOCIETY OF
AUTOMOBILE ENGINEERS
1790 Broadway, New York

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S. A. E. Bulletin

VOL. VI MAY, 1914 No. 2

Published monthly by the Society of Automobile Engineers
1790 Broadway, New York
HENRY M. LELAND, President. COKER F. CLARKSON, Secretary.
HERMANN F. CUNTZ, Treasurer.

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SEMI-ANNUAL MEETING 1914

CAPE MAY, N. J., JUNE 23-26

PROGRAM

Tuesday, June 23

Standards Committee meeting—2 p. m.
Meeting of Boards of Governors of Sections—8 p. m.

Wednesday, June 24, 2 P. M.

BUSINESS SESSION

President's Address.

Treasurer's Report.
Report of Tellers of Election of Members.
Discussion of proposed Constitutional Amendment.
New Business.

PROFESSIONAL SESSION

Report of Research Division—David L. Gallup, Chairman.
Report of Iron and Steel Division—Henry Souther, Chairman.
Report of Miscellaneous Division—John G. Utz, Chairman.

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Thursday, June 25, 9.30 A. M.

PROFESSIONAL SESSION

Report of Pleasure Car Wheels Division—Henry Souther, Chairman.

Tolerance Specified in Connection with the British Standards of Rims for Pneumatic Tires—E. R. Hall.

Possibility and Difficulties of Formulating Acceptable Recommendations for One Standard Felloe Band for Wheels to Be Equipped with Pneumatic Tires—C. C. Carlton.

A General Summary of the Truck Tire Situation*—J. E. Hale.

Report of Springs Division—Harold L. Pope, Chairman.

Ignition and Starting Devices—A. D. Libby.

Electric Transmission for Motor Cars—J. B. Entz.

Thursday, 2 P. M.

The Ideal Car*—Introduction of discussion by C. E. Davis.

Possible Weight Reduction of Cars—A. P. Brush.

Necessary Elements of Design for a Successful High-Speed Motor—D. McCall White.

Motor Capacity for Motor Vehicles—C. T. Myers.

Report of Electrical Equipment Division—A. L. Riker, Chairman.

Report of Electric Vehicle Division—A. J. Slade, Chairman.

Report of Broaches Division—C. W. Spicer, Chairman.

Friday, June 26, 9.30 A. M.

PROFESSIONAL SESSION

Tap Drill Sizes and Causes of Stripped Threads*—H. E. Harris.

Report of Motor Testing Division—J. O. Heinze, Chairman.

Report of Ball and Roller Bearings Division—Howard Marmon, Chairman.

A Proper Basis for Road Vehicle Taxation—C. O. Egerton, S. I. Fekete.

Proper Characteristics for Automobile Engine Oils—Prof. David L. Gallup.

*Printed in this Bulletin.

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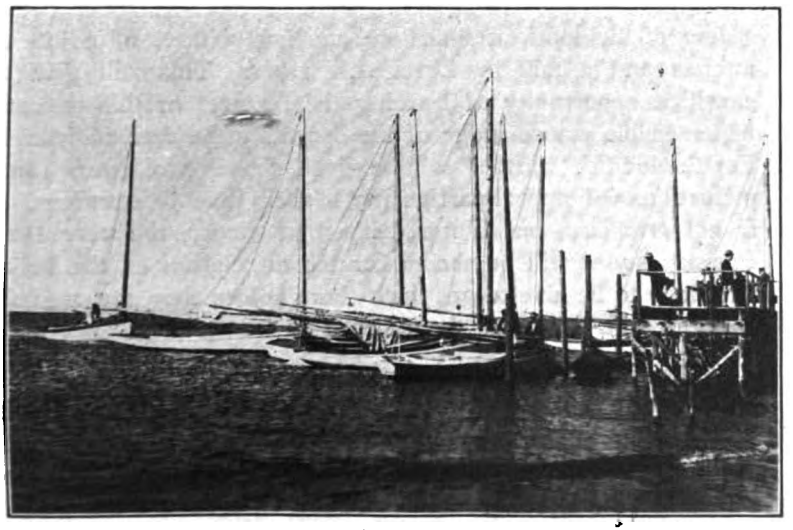
Reservations at the Hotel Cape May are being made rapidly, and it is our advice that you make immediate application for accommodations by writing to Mr. James E. Galbrey, Hotel Cape May, Cape May, New Jersey.

It is trusted that as many members as possible will drive to the meeting in their new model car, giving the attending members an opportunity to see the latest developments of the art. Routes to Cape May from both New York and Philadelphia are given herein, as well as a road map of a portion of New Jersey.

ENTERTAINMENT FEATURES

"Welfare" demands a certain amount of relaxation. Therefore entertainment features have been scheduled. The first occurs on Wednesday evening when the visiting members will be entertained by "players" from the Sections. On Thursday night the regular banquet will be given, tendered with the compliments of the hotel management. This will be followed by an illustrated lecture describing the main features of the coming Second European Visit of the Society (October 9-November 22), con-



The Fishing Fleet.

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Cool and Comfy.

sisting of stereopticon slides and moving pictures of points of interest and a talk by Orrel A. Parker. This will give an excellent opportunity of learning the features of this trip and better enable you to judge of the benefits to be derived from it. For the kiddies "movies" will be given, showing, of course, such pictures as will appeal particularly to their juvenile emotions. *It is not promised,* but if not delayed in transit, the very latest Parisian styles will be shown for the delectation of the ladies. We hope to be able to get them there before they are radically changed (the styles, not the ladies).

Following the adjournment of the professional sessions Thursday noon, Emperor High-Jinks will reign supreme, with F. E. Moskovics as Prime Minister. The proclamation sent you by Mr. Moskovics is an able statement of his plans for this feature of the meeting.

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As to the ladies, we beg to quote from our circular on the meeting. "It is particularly desired that as many ladies as possible take part in this meeting and arrangements for their entertainment are being made. The hotel orchestra will play every morning, and at the same time competent dancing instructors will be in attendance to teach those desiring to learn the new society dances. Tea will be served in the lounge during the afternoon. Dancing in the Ladies' Cafe every evening. Bridge parties, bowling contests and tennis tournaments, as well as golf games, will be arranged by the Ladies' Entertainment Committee."

To sum up, considering the professional advantages to be gained, combined with the unparalleled opportunity to meet others in your line of endeavor, and in view of the fun you will have, *we don't see how you can stay away.* Remember that for a week you will be living by, on and in the grand old Atlantic Ocean, with all its attendant delights. Do not miss the succulent clam, the aristocratic lobster (without bright lights), the dainty crab and the really truly "fresh fish." CAN YOU AFFORD TO MISS THE MEETING?

GENERAL COMMITTEE ON ARRANGEMENTS

Among the possibilities.

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AUTOMOBILE ROUTE FROM NEW YORK TO CAPE MAY, N. J.

MILEAGE COMPUTED FROM AUTOMOBILE CLUB OF AMERICA

S O — Straight on
X — Cross (trolley, etc.)
R R.— Railroad
F. M. R. — Follow main road

NOTE—Mileages follow directions and landmarks, thus:
S O X bridge 25.0 X R R 25.5, turn left 26.3, etc.

Miles

0.0 **NEW YORK.** South on Broadway to Staten Island Ferry 5.0. S O to Staten Island Ferry 5.1, X ferry to

5.1 **ST. GEORGE.** From ferry left up hill at Borough Hall turn left 5.4, follow trolley on Central St., pass green 5.8, turn right leaving trolley into Hannah St. 6.0, one block, turn left Van Duzer St., follow trolley, S O Richmond Rd., bear right 8.8, follow trolley thru

10.5 **GRANT CITY.** At cafe left fork leaving trolley in **New Dorp** 11.2. S O Amboy Rd., at tavern left fork 12.2, X RR 13.2, thru **Great Kills** 13.7. Bear right 13.8, at tavern bear left 15.7, S O thru **Huguenot** 16.4. Bear left at **Princes Bay** 17.9. X RR 18.0, bear right 18.1, turn right 20.1 X ferry at **Tottenville** 20.5. From ferry S O Smith St., up hill to hotel turn left into High St. 20.7, at monument right fork in

20.8 **PERTH AMBOY.** At once bear right into Market St., X RR 21.3, turn left with trolley into Sheriden St. 21.7, X long bridge Raritan Riv. 22.1, turn left with trolley 23.0, under RR 23.5 and 23.7, at church turn left into Broadway in

23.9 **SOUTH AMBOY.** Follow trolley, turn right with trolley into Bordentown Ave., 24.4, turn left with trolley into Pine Ave. 24.9. Caution—For sharp curves, bear left X RR at **Morgan** Sta. 26.8, X bridge, at store turn right in outskirts of **Keyport** 30.3. Right fork 30.8, follow trolley, X RR at sta. 31.6, S O thru

32.2 **MATAWAN.** X RR at **Freneau** Sta. 33.2. X RR at **Wickatunk** Sta. 36.9 X bridge 38.7, thru **Marlboro** 39.4. S. O. Broadway becoming Main St., at Court House turn left into South St. in

43.4 **FREEHOLD.** X RR 43.5, at P O turn right in **Adelphia** 46.8. F M R X speedway 55.0, S O Madison Ave. to Second St. in

55.9 **LAKEWOOD.** From 2d St. and Madison Ave. go west on Madison Ave., at lake bear left 56.1, X bridge 56.4, at once X RR, F M R thru

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66.2 **TOMS RIVER.** X bridge 66.3, X RR at sta. 66.4 at once turn left, X RR 67.1, X RR 67.6, S O thru **Bayville** 70.4, **Lanoka** 73.4 and

75.8 **FORKED RIVER.** X RR 76.7, X RR 78.3 thru cross-roads in

79.3 **WARETOWN.** S O thru **Barnegat** 82.5 X RR 83.3, bear right X bridge in **Manahawken** 86.9, S O thru **Cedar Run,** 87.9, X RR in **Staffordville** 86.9, X RR 90.5, S O thru West Creek 91.9, and **Tuckerton** 94.8, X bridge 99.8, X causeway and bridge 100.5, S O thru **New Gretna** 102.9. Sharp turn left 103.6, F M R across **Salt Meadows,** X long bridge 106.4, pass Soldiers' Monument 106.9, turn left 108.5, thru **Port Republic** 109.6, X bridge 109.8. F M R thru **Smithville** 112.5, **North Absecon** 116.3, X bridge and RR in **Absecon** 117.9. Follow trolley X RR 120.2, X RR in **Pleasantville** 120.4. Turn right into Washington Ave. F M R, X RR 131.1, X bridge and RR 132.4, pass Court House in

132.8 **MAYS LANDING.** End of road turn left, X bridge 133.2, X RR at sta. 133.5, X bridge and bear left 135.0, left fork 138.2, X bridge 145.3, left fork in

145.6 **TUCKAHOE.** Turn right 147.4, X RR 147.7, at once turn left, X RR 148.8, X RR 150.1, X RR in **Greenfield** 151.0. End of road turn right 152.6, X RR in **Ocean View** 154.8, pass road on left 155.3. Pass church on right 155.8 S O thru **Clermont** 157.8 and **Swainton** 159.8, X RR 163.3, pass road on left at

163.8 **CAPE MAY COURT HOUSE.** S O X RR 166.5, thru **Whitesboro** 167.2, X RR 167.8, pass road on left 169.3, X RR twice 170.3, X RR 171.8, X RR twice 172.2, thru **Erma** 173.3. Pass road on left 174.5. **(For Hotel Cape May turn left.)** S O Broadway thru **West Cape May** 176.3. Turn left into West Perry St. 176.9, X RR 177.1, X bridge and bear right into Jackson St., 177.2, S O to Beach Ave. in

177.5 **CAPE MAY. Hotel Cape May. Hotel Garage.**

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AUTOMOBILE ROUTE FROM PHILADELPHIA TO CAPE MAY, N. J.

S O Straight on
X — Cross (trolley, etc.)
RR.—Railroad
F. M. R. — Follow main road

NOTE—Mileages follow directions and landmarks, thus:
S O X bridge 25.0 X RR 25.5, turn left 26.3, etc.

0.0 **PHILADELPHIA.** From Public Buildings south on Market St. to ferry, X Delaware Riv. 1.3, from ferry, S O Federal St., at Court House turn right into Broadway in

2.0 **CAMDEN, N. J.** Under RR 2.1, over RR 3.9, X bridge 4.4, follow trolley, X RR 4.7, left fork leaving trolley in **Gloucester** 4.8. S O Broadway, X bridge 6.2, X RR 6.4, X bridge 6.9, at water trough left fork in **Westville** 7.0, X trolley 9.9, at church bear left 11.5, at crossroads turn right in **Fairview** 13.3; S O thru **Hurffville** 15.2. Bear left 17.5, bear left 19.0, X RR in

19.3 **GLASSBORO.** S O thru **Clayton** 22.3 and **Franklinville** 24.9. Caution—X RR 27.4, S O thru **Malaga** 28.6. X RR in outskirts of **Vineland** 34.7. X RR 40.6, and 41.1, S O Second St., X Main St. in

41.4 **MILLVILLE.** S O, follow trolley, leave trolley 42.1, X bridge 47.7, right fork in **Elizabeth** 47.8, X RR in **Bricksboro** 48.8. Bear left 49.7, left fork 50.3, X RR 50.8, thru **Dorchester** 51.3, end of road turn left X RR in

52.4 **LEESBURGH.** S O, left fork 53.4, at church right fork in **Delmont** 56.4, X bridge 57.9, at church turn right in **Eldora** 58.9. Pass pond and turn right in **Dennisville** 64.2. X bridge 64.8, pass road on left 65.5. Right fork 65.7, at P. O. Turn left in **Goshen** 68.6. Turn right 68.9, left fork 69.4, X RR 72.7, turn left 72.9, X RR 73.1, at bank turn right at

73.2 **CAPE MAY COURT HOUSE.** S O, X RR 75.9, thru **Whitesboro** 76.8, X RR 77.5, pass road on left 78.9. X RR twice 79.9, X RR 81.2, X RR twice 81.6, thru **Erma** 81.7. S O Broadway, pass road on left 82.9. (For **Hotel Cape May** turn left.) S O thru **West Cape May** 85.1. Turn left into West Perry St. 85.3. X RR 85.5, X bridge and bear right into Jackson St. 85.6, S O to Beach Ave. in

85.9 **CAPE MAY.** Hotel Cape May. Hotel Garage.

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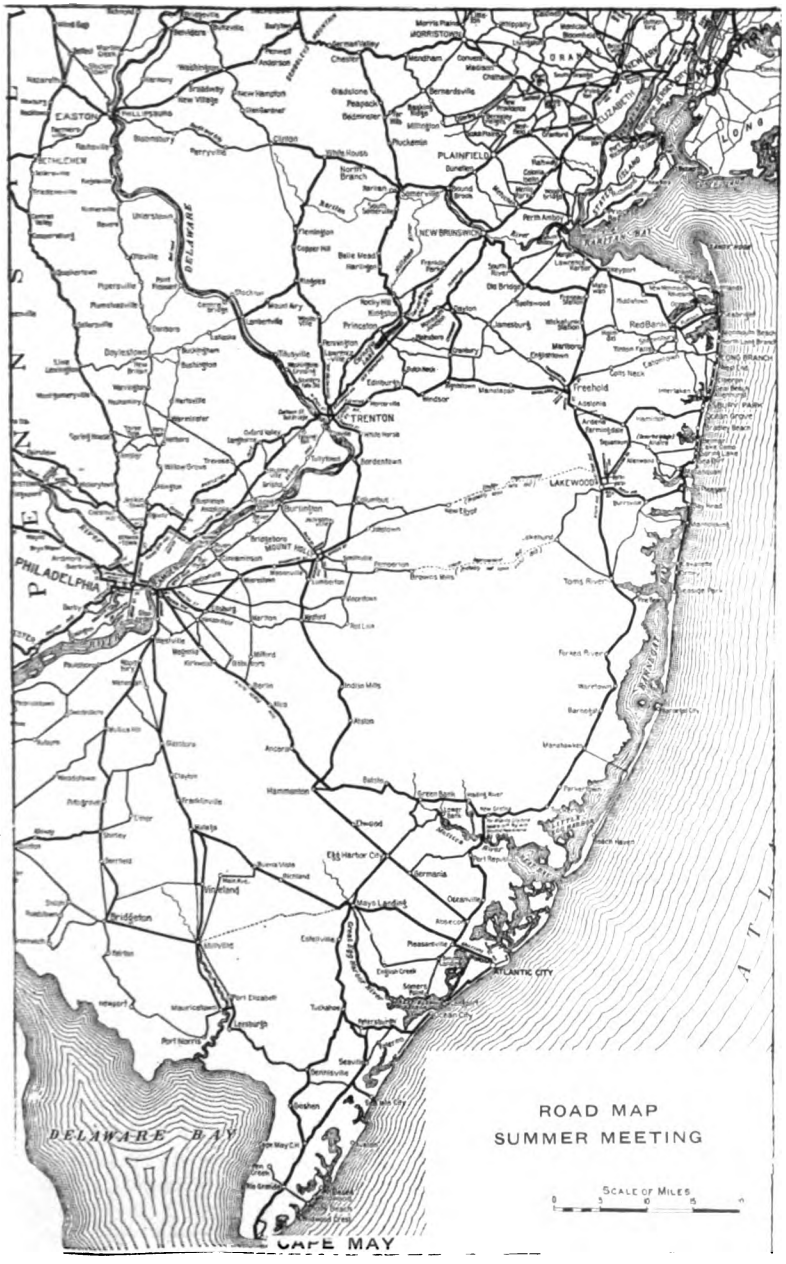

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Submitted for Discussion—not in effect until accepted by the Society of Automobile Engineers.

FIFTH REPORT OF ELECTRICAL EQUIPMENT DIVISION

Whereas the Electrical Equipment Division has spent considerable time in studying the trend of design, and as the trend of design with regard to the points specified below is clear, the following recommendations are made:

TEMPERATURE TEST OF INSULATING MATERIALS OF ELECTRICAL APPARATUS ON GASOLINE AUTOMOBILES

All insulating material used in connection plugs, sockets and similar devices of electrical apparatus for use on gasoline automobiles shall be capable of withstanding for thirty minutes a temperature of 300° F.

WIRING SYSTEM

The single-wire system with grounded return shall be recommended practice.

Respectfully submitted.

ELECTRICAL EQUIPMENT DIVISION,
Andrew L. Riker, *Chairman.*

NOTE.—It is the intention of the Electrical Equipment Division to recommend practice for designs of fittings for complete single-wire systems of electrical apparatus on gasoline automobiles.

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Paper for Summer Meeting.

TAP DRILL SIZES AND CAUSES OF STRIPPED THREADS

By H. E. Harris*

There are many arguments in favor of a tap drill list which can be applied to commercial practice. All tables which have ever come to the writer's notice have been incorrect from a practical standpoint, as they either gave a 100 per cent. depth of thread or have approximated it. They were evidently figured out very conscientiously by someone who never had to tap holes. But a worse condition than having a tap drill list that should not be followed, is to have someone who ought to know better insist that a table be followed because it is given in some handbook; that it must be right in spite of torn threads, broken taps, half reamed out holes, etc.

EFFECT OF USE OF IMPRACTICABLE DRILL LISTS

One factory labored under such a condition for a long time, all tap drill holes in the jigs being made religiously wrong, that is to give a 100 per cent. thread according to the table properly issued and approved, and the condition was not changed until after a couple of years' work between a liberal-minded chief inspector and the tapping and screw-machine departments, during which time an unofficial table, allowing a depth of thread varying from 45 to 80 per cent., to meet different conditions, was made up and all tap drill holes redrilled free-hand sub-rosa in the tapping department to these sizes and the results carefully watched. Before this there had been much trouble because the operators would redrill the holes on their own responsibility and often get them much too large.

A confession of the deviation from orders was made and the matter was put up for revision. A thorough investigation was made and the findings were that no fault could be found with the results, and that the tapped work was better and less expensive, even with the extra redrilling operation. The table that had been evolved and corrected was then adopted, and the tool room was soon busy changing the drill bushings in the jigs to provide the proper tap drill sizes.

TENDENCY TO REAM INSTEAD OF TAPPING

A tap to start into a hole must not only cut but lead itself in. In Fig. 1 is shown a portion of one land of a tap in a hole which would leave a 75 per cent. thread after tapping. The point of the tap is made slightly smaller in diameter than the tap drill hole. The tap cuts successive chips at A, A', A'', A''', until the full thread is produced. The resultant force required to send the tap through the work is a combination of a rotary force to cut or ream the chips out and a forward thrust force

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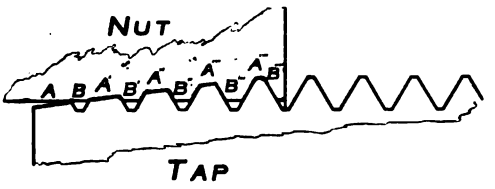

Fig. 1—Tap land in 75 per cent. Tap Drill Hole.

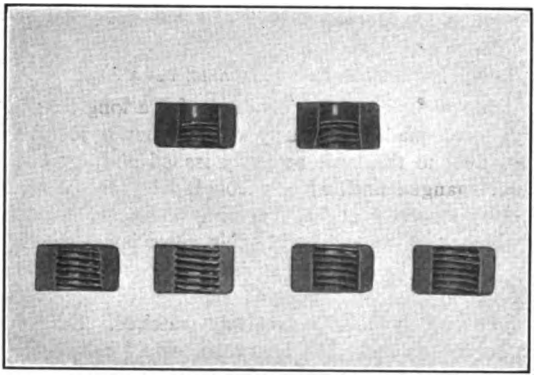

Fig. 2—Reaming by tap caused by too small tap drill hole.

to guide the tap ahead as it cuts the thread. The first of these forces is supplied by the tap wrench or machine spindle; the second, except in a few rare cases, should be supplied by the tap itself after the first initial "bite." That is, the surfaces *B*, *B'*, *B''*, *B'''* in Fig. 1, are non-cutting and by their resistance to the backward thrust of the tap should convert part of the rotary force into a force to carry the tap forward. Obviously, if for any reason surfaces *B* are inadequate, the tap will not be carried ahead, but will ream.

With a 75 per cent. depth of thread the surface *B* is backed up by a broad section and as the tap in the walls of the thread has no clearance to the cutting edge, the surface *B* acts as an efficient guide and carries the tap ahead as it cuts.

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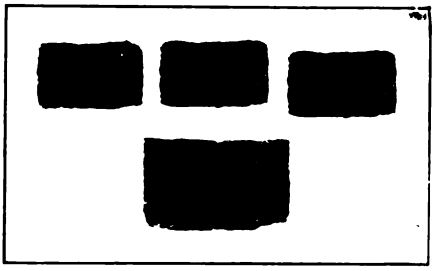

Fig. 3—"Stepped" thread, result of undersize Tap Drill.

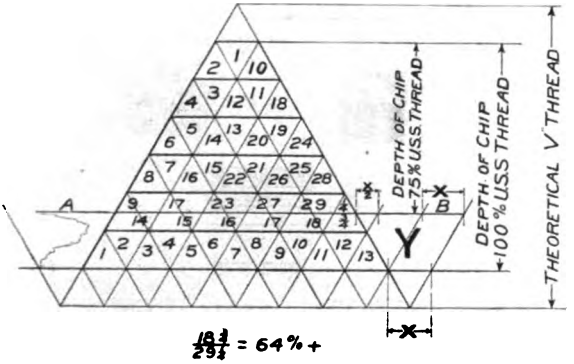

Fig. 4—Proportion of areas of chip in 75 and 100 per cent. threads.

WHY TAPS REAM AND "STEP" WITH 100 PER CENT. THREAD

Fig. 2 shows cases where nuts have been reamed by the tap because of a too small tap drill hole, and Fig. 3 shows the appearance of a "stepped" thread from the same cause. With a full or 100 per cent. depth of thread the resistance to the rotary force is much greater as the area of the chip removed, as shown in Fig. 4, is 64 per cent. greater, the profile of the 100 per cent. and 75 per cent. being plotted off into triangles numbered to show the relative areas.

In addition to this the leading or guiding surfaces at *D*, *D'*, *D''*, *D'''*, for a 100 per cent. thread, as shown in Fig. 5, are much narrower and weaker at the starting of the tap, and the end of the tap is apt to act as a taper reamer and cut off these slight projections, thereby depriving the tap of its ability to lead itself into the work. This shows how unfavorable to good threading a 100 per cent. depth of thread is, if only this one condition, viz., greatly increased resistance to the forward travel

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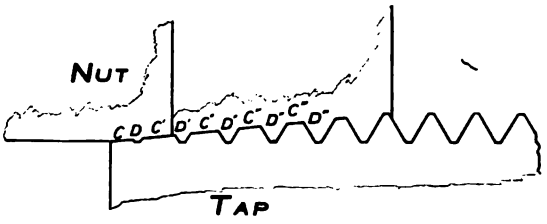

Fig. 5—Weak leading ridge in 100 per cent. thread.

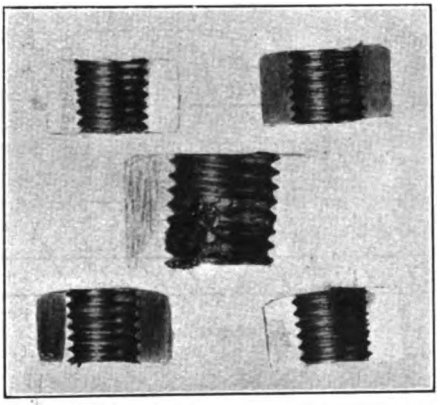

Fig. 6—Stepped, torn and crossed threads; 100 per cent. Tap Drill Hole.

of the tap and the greatly decreased leading ability alone, are considered with the attendant reaming and "stepping" of the threads.

OTHER DISADVANTAGES OF 100 PER CENT. THREAD

Trouble is not experienced from these results alone; torn threads are obtained from taking too heavy a chip; the tap meeting such resistance to forward action is pushed back and will cut short lead and narrow threads with wide spaces. Also the metal, having no space to flow at the apex of the threads, will cause a binding of the tap in the threads which have no clearance in the wall surfaces at this point, causing the metal to become torn and often binding and breakage of the taps. Fig. 6 shows actual results in nuts which were caused by tapping into a 100 per cent. tap drill hole. You will note that these nuts are stepped, torn, and even "crossed" where the tap lost its initial bite, and caught a second time before tapping through the nut.

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OTHER FACTORS THAN DEPTH OF THREAD OF MORE IMPORTANCE FROM STRIPPING STANDPOINT

Torn, crumbled, crossed, reamed and stepped threads are all prolific causes of stripping, and when produced with properly made taps are generally due to too small tap drill holes. There are, however, other factors that are greater causes of stripped threads. Threads that are imperfect on the angle, being less than 60 degrees or hollow, thereby having a weaker section, increase the tendency to strip; threads that have too great a difference in pitch diameter sizes reduce the effective triangular area of the thread and thereby its resistance to stripping; an error in lead, although not generally so considered, is one of the most frequent and unsuspected causes of stripped threads.

ERRORS IN LEAD NOT ABSOLUTELY AVOIDABLE

The effect of errors in lead on the stripping of threads is very marked. Commercially it is practically impossible to avoid minute errors in lead. A dull die as it becomes duller tends to cut a shorter lead, that is the normal number of threads per inch occupy less length than one inch. Likewise a tap will cut an incorrect lead, although the spacing of its own teeth may be practically perfect if it is improperly made or if the tap drill hole is too small.

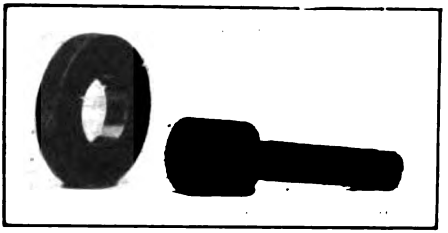

Fig. 7—Ring and plug thread gages.

IMPOSSIBLE TO DETECT ERRORS IN LEAD WITH ORDINARY GAGES

The ordinary way of measuring threads is to test the work by gaging the hardened plug or ring thread gages, as shown in Fig. 7. When these are home-made they are apt to be incorrect, due to lack of precision machinery to generate a correct lead and also to irregular and inadequate methods of hardening. In addition, it is practically impossible to tell whether there are any errors in lead by this method even though the gage be correct. In this way of gaging, which is slow and laborious, the gage is screwed onto the piece, and the screw diameters reduced by closing in on the die until the gage will screw on all the way. For each 0.001 inch error in lead, per inch, with a thread gage one inch long, the pitch diameter has to be reduced 0.0017 inch, irrespective of the number of threads per inch. In this way, by a few thousandths error in lead, threads are produced which soon become loose because the original fit is only on the end threads.

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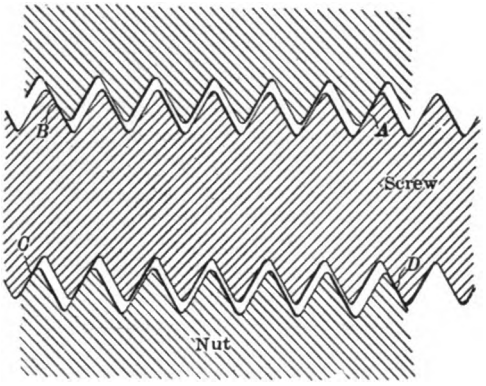

Fig. 8.—Diameter of screw reduced on account of error in lead.

EFFECT OF ERRORS IN LEAD ON FIT

Fig. 8 shows this effect of error in lead. A difference in diameters of the screw and nut has to be allowed, and yet the screw is tight in the nut, binding at *A*, *B*, *C* and *D*. These points, however, soon wear or upset, resulting in a loose fit.

WHY ERRORS IN LEAD SOMETIMES CAUSE STRIPPING

Not only in this way do we lessen, by looseness and decreased effective thread area, the shear-resisting strength, but if the lead on the screw is long *i. e.*, if the normal number of threads per inch occupy more than an inch), or if the lead in the tapped hole is short, or if both these conditions exist together, or if, in any combination of errors, the lead of the screw is longer than the lead of the nut or tapped hole, we have an ideal condition for stripping. In other words, such conditions provide what is termed a "shear cut" by blanking and shearing machinery builders.

EFFECT OF LEAD ON SCREW BEING LONGER THAN LEAD OF TAPPED HOLE

Fig. 9 will make this clear, with the following explanation: Here we have contacts at *A*, *B*, *C* and *D*. The thread at *A*-*B* in the nut takes the entire strain of the screw as it is tightened and that at *D*-*C*, being on the opposite side from the pressure, tends to open as the screw is tightened. The tendency of the strain concentrated at *A*-*B*, instead of over all the thread, is to strip or upset and weaken the thread at this point. A continuation of the tightening operation would extend the stripping action progressively along the helix, with a shearing action as shown graphically by the diagram in Fig. 9. Thus it is seen that errors in lead not only affect the diameter sizes and the overlap and are thus vital factors in the fit and strength of the thread,

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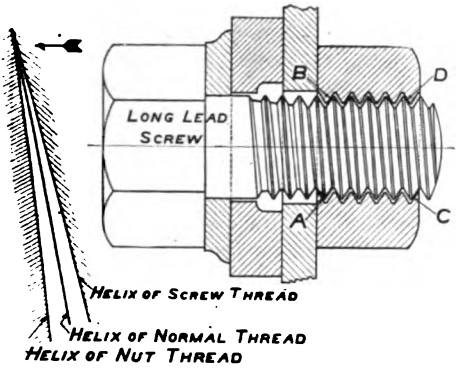

Fig. 9.—Long lead screw with short lead tapped hole and diagram of shearing action

but that they are also apt to furnish the very best means for shearing or stripping threads that could be planned. More vital then is proper measuring or gaging of threads to see that the lead is correct and the pitch diameter of the screw up to size than the mere matter of testing the threads with a threaded gage, which only insures that they screw together no matter how inaccurate they are.

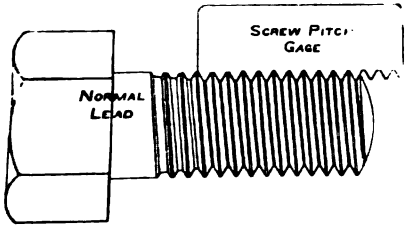

Fig. 10.—Screw pitch gage checking normal thread.

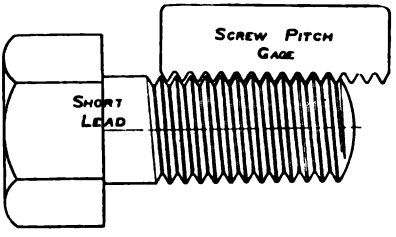

Fig. 11.—Screw pitch gage rejecting short lead

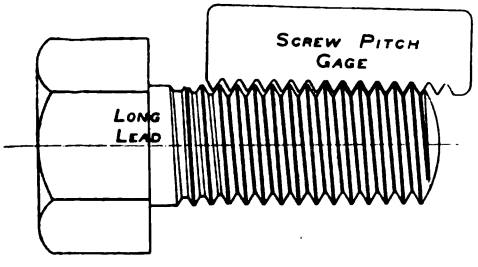

Fig. 12.—Screw pitch gage rejecting long lead

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TO MEASURE LEAD SIMPLY AND WITH COMMERCIAL ACCURACY

A simple and inexpensive means for measuring the lead of threads is rapidly coming into general use. I refer to the gages shown in use in Figs. 10, 11 and 12. These gages are very accurate and with little practice an inspector or operator can detect such slight errors as .002" per inch, and detect instantly whether the lead is short or long. In Fig. 10 normal lead is proved. Fig. 11 shows how readily a short lead screw is detected. In Fig. 12 a long lead screw is shown. The difference between this and the two former figures is very apparent.

Fig. 14.—Just right; the screw has passed the upper points but hangs on the bottom points

Fig. 13—Too large; the screw will not pass the upper points.

Fig. 15—Too small; the screw has passed both sets of points.

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TO MEASURE PITCH DIAMETER AND HOLD IT WITHIN LIMITS

In order to measure the pitch diameter separately rather than screw it blindly into a threaded hole gage, another simple and yet accurate form of gage is now widely used. That is the fork limit thread gage shown in Figs. 13, 14 and 15, which are self-descriptive. This gage not only permits the rapid inspection of threaded work (from 500 to 1,000 per hour), as its conical points are correctly ground and fit the angles of the thread, but it checks the angle, allows the proper working limits and is tamper- and fool-proof. It will work under conditions of oil, dust, chips, etc., with accurate results.

CONTROLLING ERROR IN LEAD TO PRODUCE BENEFICIAL RESULTS

As stated, it is practically impossible to eliminate all errors in lead in screw and tapped hole. How, then, will gages help us? And how can we avoid all the serious trouble pointed out? By gaging and careful selection of threading tools and machinery we can first get the work as accurate as practicable; and then, by confining the unavoidable commercial errors by allowing tolerances on the right side of the normal line, we can avoid upsetting, shearing and stripping.

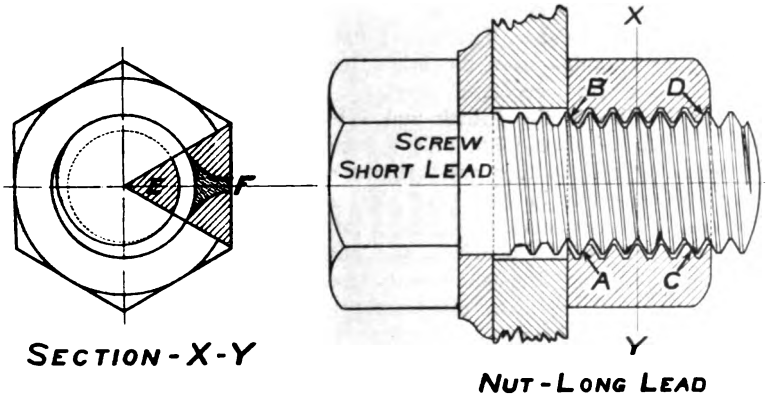

Fig. 16.—Relative strength of nut and screw and correct combination of short-lead screw with long-lead nut

I will use Fig. 16 to illustrate this.

At the bottom, section *X-Y* through the screw and nut shows the relative sectional strength. The area of 1/6 of the screw at *E* is seen to be contained at least three times into the cross-section of the nut at *F*. We can therefore safely assume the stronger nut to be absolutely inelastic under any strains applied through the medium of the weaker screw. Referring to the right-hand view we have a screw with a *shorter* lead than the nut and coming in contact when the screw is tightened, at *C-D*. As the screw is drawn further to a seat the other portions of the thread also come into contact, with the elasticity and

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elongation of the screw, until the full length of the thread, including portion *A-B*, is fully in contact. *This condition would really seem more ideal than to have the threads absolutely perfect in lead,* as we utilize the elasticity of the screw to aid in distributing the pressure over the entire length of the thread contact, rather than have it fall on portion *A-B* alone.

SCREW LEAD SHOULD BE "SHORT" TAPPED, HOLE LEAD "LONG"

In other words, good thread work must be governed by the rule that the lead on screws should never be longer than the normal and the lead on tapped holes should never be shorter than the normal.

DEEP OVERLAP NOT CONSIDERED NECESSARY

Passing from some of the most prolific causes of stripped threads, we will take up the matter of overlap. The time was when sharp V threads were used in order to get as much overlap as possible (?). This is questioned because it is mechanically impossible to produce a theoretically sharp V thread. The Sellers form of thread was demonstrated before the Franklin Institute to be more effective and stronger than the V thread and adopted as the United States standard. This form of thread is specified in S. A. E. Screw Standard and in the International Standard. The use of the U. S. *form* of thread is yearly making great gains over the other forms and nobody seems to find any ill effects from decreased overlap.

The English in the British and Whitworth forms have not only a lesser depth of thread but still further decrease the effective overlap by rounding off the tops and bottoms of the threads. They have not sacrificed strength in this case, for the decreased overlap does not decrease the shear-resisting strength of the thread; and the rounding at the base furnishes a reinforcing filler to stiffen the thread. I am not advocating the English thread, however, as the rounded form, in my opinion, has too many disadvantages to rank with the U. S. form; but wish to drive home the argument that greater overlap has not been considered generally conducive to shear-resisting strength.

SUFFICIENT OVERLAP

Then what constitutes sufficient overlap? It is the opinion of many capable men, after a study of the theoretical side of the matter and extensive practical tests, that sufficient overlap is had by retaining that portion of both the screw thread and the nut thread which, in combination, offers the greatest resistance to shear obtainable, enough extra metal being allowed to prevent a spinning-over or burring action.

DIFFERENCE IN PITCH DIAMETERS MORE DANGEROUS THAN SMALL OVERLAP

Overlap as a factor to resist stripping is not nearly as important as proper fit on the pitch diameter. When there is considerable difference between the pitch diameters of the tapped hole and screw, whether from incorrect gaging, or to allow for errors in lead, or because of poorly made or off-size taps and dies, the section of the thread is weaker

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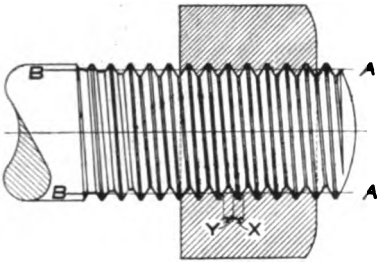

Fig. 17.—Greatest shear-resisting strength in threads.

where the combination of the greatest strength is made and the tendency to burr over and strip thereby greatly increased.

ILLUSTRATION OF DIFFERENT AMOUNTS OF OVERLAP

In Fig. 17 we have the greatest resistance to shearing approximately along the pitch diameter lines *A-B*, where portion *X* on the screw has the same width as *Y* on the nut.

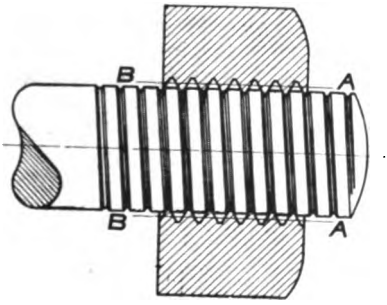

Fig. 18.—Shear-resistance minimized by removal of area of greatest strength on screw threads.

While in Fig. 18 the shear-resistance of the screw alone is very great but limited by the small section of support at the tops of the thread in the nut.

In Fig. 19 the U. S. form of thread is shown. A glance will convince those familiar with screw-thread work that there is more than sufficient overlap, and yet the thread in the nut has 25 per cent. of its depth removed from the tops of the threads; there is more than sufficient extension beyond the pitch diameter lines *A-B* to prevent any burring action. This thread has a wide margin of strength over the lower

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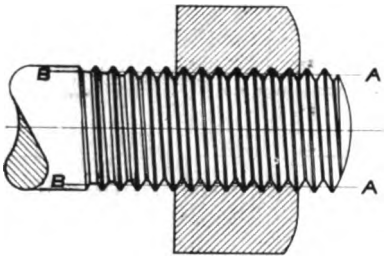

Fig. 19.—Greatest shear-resisting strength retained in 75 per cent. depth of thread in tapped hole

necessary to cause the screw to elongate and fail through its root diameter section.

WHY 75 PER CENT. DEPTH OF THREAD IS RECOMMENDED

Seventy-five per cent. depth of thread is more desirable than 100, because, in addition to improved threading, it results in a vast reduction of breakage of taps. A common saying in regard to taps is that 90 per cent. break instead of wearing out. This is doubtless at least approximately true in average tapping practice. This means not only large tap expense but expensive delay in getting new taps and resetting machines, and, not least by any means, the costly processes used with occasional success to remove broken taps and the expensive pieces rendered useless by having broken tap-ends left in or having the tap holes spoiled in the attempt to remove the taps. This waste is almost altogether unnecessary and can be easily avoided by properly designed taps and proper sizes of tap drill holes.

MAKING STRONGER AND EASIER CUTTING TAPS

Large sums have been expended in our testing room on experimental work, developing a tap so designed as to have correct cutting angles, plenty of chip clearance where most needed, and increased strength at the portions of greater strain, as shown by the place of the majority of fractures in broken taps, throughout the different tests and in general shop practice. By making careful research in the matter of improved steels and heat treatments to conserve the elements of elasticity, strength and durability of cutting edges, and by strengthening the taps at vital points and making them cut easy and without clogging, taps were produced which would stand up much longer than theretofore.

FACTOR OF SAFETY OF TAPS

The average factor of safety of taps is usually considered as 2, although a great many taps have none at all in a 100 per cent. hole. The Wells design of tap has a factor of safety *at least* 3, when tapping a *full thread* in open hearth machinery steel.

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FACTORS OF SAFETY IN WELLS DESIGN TAPS IN DIFFERENT MATERIALS

MATERIAL	FACTOR OF SAFETY	
	75% Tap Hole	100% Tap Hole
Drawn Brass	19	7
Cold Punched Hexagon Nuts	8	3
Drawn Screw Stock	8	3
Drawn Phosphor Bronze	5	1
Crucible Tool Steel 1.25% Carbon	4	0.5

Lubricants: Lard or Sperm Oil
United States Standard Thread Taps
kept in commercially sharp condition.

Fig. 20.

By tapping into a tap hole that will have a 75 per cent. thread, the factor of safety of all taps is materially increased. An average of a large number of tests shows conservative factors of safety in different materials as shown in the table given in Fig. 20. These figures are for the U. S. S. threads. It is reasonable to believe that the S. A. E. thread taps, due to the much finer thread in proportion to diameter, would have a larger margin of safety.

PROPER LUBRICATION RAISES FACTOR OF SAFETY

The table represents what can be expected under proper conditions. Poor lubricant or absence of lubricant will cut down tap efficiency 50 to 100 per cent. To save unnecessary repetition, the writer would refer those interested in the matter of lubrication to the paper entitled Taps and Screws presented before the American Society of Mechanical Engineers, March 12, 1912; which illustrates the different forms of cutting edges for taps, comparing proper and improper forms, and giving results obtained; and discusses the value of angle accuracy in threads, the effect of warped taps upon work, the powers required in tapping different materials, the indication of tapping efficiency by the form of chip produced, and the cause of chattered threads.

ENDORSEMENT OF 75 PER CENT. DEPTH OF THREAD

The recommendation of a 75 per cent. depth of thread in a tapped hole as standard practice has received the endorsement of many large users, the General Electric Company for one using practically this allowance, having arrived at its use in their own practice. While the writer was head of the mechanical departments of the Western Electric Company he evolved a table of tap drill sizes which, after a series of trials and experiments covering a couple of years and considerable consultation with tap makers, screw machine and tapping department heads, assemblers, inspectors and engineers, was finally adopted and put into standard use in this company, and gave complete satisfaction under their conditions.

In this table of sizes, which applied to tap sizes one-half inch diameter and less, the different materials were taken into considera-

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tion on the principle, verified by actual and continued practice, that different materials give different results in tearing, spinning and crumbling at the tops of the thread, according to whether their nature is stringy like in the case of copper or brass and steel for drawing purposes, or easy cutting and ductile, as in the case of leaded brass, or crystalline and apt to crumble at the tops of the thread as with cast iron and cast aluminum, or elastic as in the case of hard rubber, which will expand under the heat of drilling so as to actually permit cutting a hole which, after withdrawal of the drill and cooling, is several thousandths smaller than the drill used.

RELATION OF DEPTH OF TAPPING TO TAP DRILL SIZE

The depth of the tapped hole was also taken as a factor, on the basis that holes are generally tapped no deeper than necessary, and that the deeper holes indicated a longer thread contact with the screw and therefore greater shearing strength and less liability to stripping. By using a larger drill size in the deep holes, the amount of work for the taps was decreased and the chips were of less bulk and consequently the tendency to clog and break the taps was greatly reduced.

Materials	Depth of Tapping	Depth of Thread
Cast Aluminum	Equal or less than ½ (O. D. of Tap)	80%
Leaded Brass		
Cast Iron	More than ½ (O. D. of Tap) but less than 2 (O. D. of Tap)	66%
Screw Stock		
Soft Steels	More than 2 (O. D. of Tap)	50%
Tough Steels	Equal or less than ½ (O. D. of Tap)	66%
High Carbon Steels		
Alloy Steels	More than ½ (O. D. of Tap) but less than 2 (O. D. of Tap)	55%
Norway Iron		
Copper	More than 2 (O. D. of Tap)	45%
Phosphor Bronze		
Drawn Aluminum		
Hard Rubber		
Hard Fibre		
High Brass		

Fig. 21.—Basis for computing tap drill sizes in different materials for electrical apparatus work

PERCENTAGE OF THREAD FOR DIFFERENT DEPTHS AND MATERIALS

Fig. 21 gives the basis on which these tap drill sizes were counted. Its adaptability to tap sizes more than one-half inch diameter, and on work other than electrical apparatus work, should be determined by test and trial before adoption. It is given here merely as an example of

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what has been done successfully in a certain case and bears on the matter in hand only as an argument for the adoption of rational tap drill sizes.

DRILLS FOR MACHINE SCREW TAPS

Size No.	Threads per Inch	Root Diameter	Drill Size	Size No.	Threads per Inch	Root Diameter	Drill Size
0	80	.044	.048	9	24	.123	.136
1	72	.055	.060	10	32	.149	.160
1	64	.053	.058	10	30	.147	.158
2	64	.066	.071	10	24	.136	.149
2	56	.063	.069	12	28	.170	.181
3	56	.076	.082	12	24	.162	.175
3	48	.072	.079	14	24	.188	.201
4	48	.085	.092	14	20	.177	.193
4	40	.080	.088	16	22	.209	.224
4	36	.076	.085	16	20	.203	.219
5	44	.095	.103	18	20	.229	.245
5	40	.093	.101	18	18	.222	.240
5	36	.089	.098	20	20	.255	.271
6	40	.106	.114	20	18	.248	.266
6	36	.102	.111	22	18	.274	.292
6	32	.097	.108	22	16	.265	.285
7	36	.115	.124	24	18	.300	.318
7	32	.110	.121	24	16	.291	.311
7	30	.108	.119	26	16	.317	.337
8	36	.128	.137	26	14	.305	.328
8	32	.123	.134	28	16	.343	.363
8	30	.121	.132	28	14	.331	.354
9	32	.136	.147	30	16	.369	.389
9	30	.134	.145	30	14	.357	.380

Fig. 22

DRILLS FOR U. S. STANDARD TAPS

Size No.	Threads per Inch	Root Diameter	Drill Size	Size No.	Threads per Inch	Root Diameter	Drill Size
1/4	20	.185	.201	1	8	.838	.878
5/16	18	.240	.258	1 1/16	8	.900	.941
3/8	16	.294	.314	1 1/8	7	.939	.986
7/16	14	.345	.368	1 3/16	7	1.002	1.048
1/2	13	.400	.425	1 1/4	7	1.064	1.111
9/16	12	.392	.419	1 5/16	7	1.127	1.173
5/8	12	.454	.481	1 3/8	6	1.159	1.213
11/16	11	.507	.536	1 1/2	6	1.284	1.338
3/4	11	.569	.599	1 5/8	5 1/2	1.389	1.448
13/16	10	.620	.652	1 3/4	5	1.490	1.555
7/8	10	.683	.715	1 7/8	5	1.615	1.680
15/16	9	.731	.767	2	4 1/2	1.711	1.783
1	9	.793	.829				

Fig. 23

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DRILLS FOR S. A. E. TAPS.
(Formerly A. L. A. M. Standard)

Size No.	Threads per Inch	Root Diameter	Drill Size
1/4	28	.204	.215
5/16	24	.258	.272
3/8	24	.321	.334
7/16	20	.373	.389
1/2	20	.435	.451
9/16	18	.490	.508
5/8	18	.553	.571
11/16	16	.606	.627
3/4	16	.669	.689
7/8	18	.803	.821
7/8	14	.782	.805
1	14	.907	.930
1 1/8	12	1.017	1.044
1 1/4	12	1.142	1.169
1 3/8	12	1.267	1.294
1 1/2	12	1.392	1.419

Fig. 24

THE WELLS TABLES OF TAP DRILL SIZES

The Wells tables of tap drill sizes—Fig. 22 for machine screw sizes, Fig. 23 for U. S. standard threads and Fig. 24 for S. A. E. threads—are safe and practical and have a wide margin of safety, as has been shown by repeated tests. They give a 75 per cent. thread, whereas a ½-inch 13 soft brass nut of ordinary length with but 50 per cent. thread when screwed onto a chrome vanadium steel bolt will, in a tensile strength testing machine, cause the bolt to part across the root of the thread without upsetting or stripping the threads in the nut. The use of these materials in this combination represents almost the extreme conducive to stripping.

IMPORTANT TO USE EXACT SIZE DRILLS.

As the ordinary size drills, known by number or fractional size, do not coincide with the correct decimal size given in the table, and in some cases do not even approximate them, and because a few thousandths variation towards a smaller hole is expensive, due to the increased percentage of tap breakage and a variation towards a larger size may be objectionable, we have been compelled to stock a complete line of decimal size tap drills. With the drill size stamped on the tap, the only excuse for error disappears. We feel that this will become standard practice as soon as the users and tap and drill makers awake to a realization of what constitutes correct and economical thread practice. We strongly urge strict adherence to the decimal sizes. Amer-

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ican drill makers now furnish their European trade with decimal size drills (metric) up to approximately 1½-inch diameter; among the smaller sizes of these drills the steps are as small as approximately 0.002 inch. The drill makers have already suggested that the metric size drills be used as tap drills in this country, but this is untenable unless we are prepared to also adopt the metric system throughout, including metric taps and metric micrometers.

Paper for Summer Meeting.

A GENERAL SUMMARY OF THE TRUCK TIRE SITUATION

By J. E. Hale*
(Member of the Society.)

The Truck Standards Division in its efforts to arrive at a universal schedule of solid tire carrying capacities satisfactory to all concerned, discovered that the situation is really quite complex and decided therefore that a synopsis of the solid tire situation as a whole might be worth while. As an introduction let me state that there is almost no opportunity to resort to theories and exact formulae in solid tire design, a fact which will be readily appreciated after consideration of the discussion which follows; experience and judgment being by far the chief requisites for producing results. It is fair to add, however, that the application of good engineering practice and methods can reasonably be expected to produce better results than could be obtained from the hit-or-miss attention of salesmen and factory workmen. It is unfortunate that the art has not progressed sufficiently to permit the presentation of data and facts which can be considered at all complete or satisfying. However, even though the absence of theories and data is so regrettable, I hope, since the truck tire problem is so intimately connected with the truck industry, to find that the following remarks will prove of interest, and especially that they may serve as a basis of starting something for the betterment of the situation.

Taken in a broad sense undoubtedly economy of truck operation is the real issue. It follows therefore that if an "economical tire" could be evolved an ideal solution would be at hand.

Solid tires in service under certain operating conditions give certain results in the performance of their functions. These results are dependent on the tires themselves and on the conditions under which the tires are used; consequently we may propose an equation which indicates a balancing condition as follows:

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$$\left[\begin{array}{c}\text{The results of service performance, which may be termed "commercial properties"}\end{array}\right] = f\left[\begin{array}{c}\left[\begin{array}{c}\text{Operating conditions}\end{array}\right] \;\&\; \left[\begin{array}{c}\text{Tire details or physical properties of the tires}\end{array}\right] \;\&\; \left[\begin{array}{c}\text{Selling cost}\end{array}\right]\end{array}\right]$$

Expanding the terms in parenthesis by itemizing the features pertinent to this discussion we have:

$$\left[\begin{array}{c}\text{Cost per tire-mile}\\ \hline \text{Durability (Total Mileage)}\\ \hline \text{Resiliency (Power Consumption)}\\ \hline \text{Cushioning-effect}\\ \hline \text{Reliability}\\ \hline \text{Service cost}\\ \hline \text{Tractive grip}\end{array}\right] = f\left[\begin{array}{c}\left[\begin{array}{c}\text{Loading}\\ \hline \text{Speed}\\ \hline \text{Spring-suspension}\\ \hline \text{Road surfaces}\\ \hline \text{Topography}\\ \hline \text{Weather}\\ \hline \text{Driver}\end{array}\right] \;\&\; \left[\begin{array}{c}\text{Structure}\\ \hline \text{Diameter}\\ \hline \text{Width}\\ \hline \text{Shape cross-section}\\ \hline \text{Tread rubber}\\ \text{Toughness}\\ \text{Attrition-resistance}\\ \text{Plasticity}\\ \hline \text{Scheme of attachment}\\ \hline \text{Weight}\end{array}\right] \;\&\; \left[\begin{array}{c}\text{Selling cost}\end{array}\right]\end{array}\right]$$

The "commercial properties," representing as they do the results of service performance, are of particular interest as they are a measure of the satisfaction received. Cost per tire-mile, durability, tractive grip, service cost, and power consumption are all capable of being expressed by exact numerical values. Cushioning effect and reliability are indefinite but none the less important.

The "operating conditions," loading, driver, and to some extent, choice of road surfaces are under the control of the truck owner. The spring suspension is wholly and the loading to some extent under the control of the truck designer. Topography, weather, and in part the road surfaces must be accepted as they are. Of the operating conditions, loading and speeding alone may be expressed in numerical values.

The items under "tire details" pertain to the physical properties of the tires themselves and are self-explanatory.

In this discussion it may be noticed that cost or money value is mentioned only in connection with the commercial properties of the tires. Of course the item of cost is present on the other side of the equation in the various subdivisions of the "tire details."

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Without being specific as to the precise relation between cost and tire details, let it suffice to say that the value of the finished product is largely in the materials which enter into its fabrication.

This equation is explained as representing a balancing condition. Of course this is true enough if we have been careful to include all the component subdivisions relative to the main parentheses of the equation. It will shortly be pointed out that practically all the terms on both sides are variables between rather wide limits and that broadly speaking the whole situation centers about what we do not know and what we want to know about the effect produced on the "Commercial Properties" by changes or alterations of the various "tire details" or "operating conditions." To take an example, we might accumulate data upon a certain tire of average "physical properties" and which had been in service under average "operating conditions" (Chicago for instance) and for commercial properties we would find the cost per tire-mile to be ¼c. The mileage given, 10,000, the power consumption, 9/10 horsepower-hour per ton-mile per tire, the tractive grip represented by an average coefficient of friction of .40, a service cost of 1¾ hours interruption of service in changing tires, and the cushioning in its effectiveness to reduce destructive vibration while not capable of definite expression in figures is nevertheless a very important and definite quantity.

Now, if we change any of the variables on the right-hand side of the equation this will naturally result in a change in one or more of the commercial properties. Assuming for instance that the speed (that is the average speed at which the truck is driven) be diminished, we will find the cost per tire-mile decreased, the durability increased, the resiliency altered, the cushioning effect increased, the reliability increased, the tractive grip probably increased and the service cost unaltered. On the other hand suppose we change one of the physical properties of the tire, say stiffen the compound. The cost per tire-mile would probably be reduced, the total mileage probably increased, the cushioning qualities decreased, the reliability unaltered, the tractive grip diminished, the service cost unaltered, and the power consumption decreased or increased according to road surfaces.

Although the circumstances are familiar to everybody, let us enter here as a matter of record and comparison the existing scheme of judging the satisfaction obtained from the service of solid tires. In a few cases, notably among the large owners, cost per tire-mile receives considerable attention, but in general it may be said that a tire which runs its mileage guarantee without developing any distressing symptoms is satisfactory, a tire that exceeds the mileage guarantee gets the business in the future, and a tire that fails to give the mileage gets a black-eye. Also it often happens that service helps to sell a tire.

The "commercial properties" should be discussed more or less in detail since they represent the satisfaction obtained from the use of the tire, and also the possibilities of choosing the best possible combination of component operative conditions and tire details to fulfill the requirements of the "economical tire." In what follows it should be borne in

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mind that economy of truck operation taken as a whole determines for our discussion the actual values of the commercial properties of the "economical tire."

COST PER TIRE-MILE

Obviously it is desirable to have the cost per tire mile as small as possible consistent with the complete qualifications for economical truck operation. This is one of the most important of the commercial properties in the matter of economy and it happens that it is dependent on practically all of the subdivisions of the operative conditions and physical properties of the tires. The better the road surfaces and more nearly level the country, the lower the cost per tire-mile. Likewise the tires will show up better under a careful driver than one who does not try to favor them. As for weather, extremes of heat and cold have a detrimental effect on the rubber, consequently increasing the cost per tire-mile. Spring suspension is mentioned as one of the operating conditions. This may seem a little far-fetched, yet we know that the efficiency of the springs in performing their functions has a very decided effect on the life of a tire.

Considering now the load on the tire and the speed at which the truck is operated, all will agree that the lighter the load and the slower the speed, the lower the cost per tire-mile, but returning to our fundamental idea of economical operation of the truck there is undoubtedly one combination of load and speed (assuming tire equipment of specific "physical properties") which will give a maximum effect in the matter of truck operating economy, yet the cost per tire-mile will be greater than were the speed to be slower and the load less. Again by simply altering one of the tire details, say stiffening the compound, an entirely new set of relations will be established, with the result that the economical load and speed will differ from those of the preceding case. Change the structure, diameter, width or shape separately or collectively and our economical load and speed have to be sought anew and also a new cost per tire-mile.

DURABILITY

Strictly speaking durability is a property which is closely allied to that of cost per tire-mile and there is a strong temptation to believe that they are inversely proportional. The principal exceptions to this are to be found in the details of the tires themselves. Thus it is perfectly possible to compound the tread rubber to give a very low cost per tire-mile and at the same time produce a tire which would give but small total mileage. The same idea could apply in the case of the structure of the tire under certain circumstances. Apparently the predominant attitude of the wide-awake truck owners is decidedly favoring the choice of tires which run long mileages. The importances of uninterrupted operating schedules is undoubtedly largely responsible for this condition; moreover it is probably true that many owners would feel justified in sacrificing, if necessary, a slight saving in tire cost if it came to the point of choosing between the two properties.

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RESILIENCY

Resiliency will presently occupy a very decidedly more prominent position in the list than it has in the past. The requirements of electric vehicle practice have for some time demanded the most efficient tires possible; some manufacturers even make the other commercial properties secondary to this one. Surely gas truck operators should recognize the possibility of greater economy from the use of efficient tires just as does the electric truck operator. An example will emphasize this point. It is very easy to pick out from among the brands and types of tires on the market those which will absorb 25 to 40 per cent. more energy than the most efficient; consequently if a 3-ton truck consumes say from $400 to $500 worth of gasoline a year, a very considerable cash saving could be made by using more efficient tires. As the rubber is "lively" or "dead" (by virtue of the nature of the compounding) so will it be efficient or inefficient when measured for power consumption. The stiffness or plasticity of the compound also plays an important part in the determination of efficient performance. Efficiency is very dependent on the character of road surface over which the vehicle is operated, particularly as to the distinction between rough and smooth road surfaces. Other things being equal the soft tread rubber will give greater efficiency on the rougher roads.

From the foregoing it will be seen that the resiliency of the tire is largely dependent on the compounding of the tread rubber. To what extent it is dependent on the other physical properties of the tire is somewhat uncertain, but surely not to any marked extent. The efficiency varies slightly with extremes of heat and cold; also with different loads and speeds.

CUSHIONING EFFECT

The invention and especially the perpetuation of the India rubber tire were possible because of the benefit derived from the cushioning properties of the rubber as a lessener of uncomfortable and destructive vibrations. How many times has it been remarked that automobiles are possible because of the pneumatic tire? Is it not true that motor trucks would not be possible without rubber tires? Just think of a 3-ton truck equipped with steel-shod wheels rattling over the average pavement at 8 to 12 miles per hour—and the poor pavement!

Of course the plasticity or stiffness of the tread rubber is by far the most important item affecting this commercial property and it goes without saying that a soft yielding compound will protect the mechanism of a vehicle better than a hard stiff one. The remaining items of tire detail each influence the cushioning effect in minor ways. It is rather unfortunate that up to the present time the tire companies have found no way of making a tread rubber of exceptional cushioning qualities and at the same time of low cost per tire-mile. We find that the softer and more yielding the stock the better its quality must be to give reasonable service, and quality represents price. This fact is also particularly

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noticeable: Tires made of soft compounds are very much more liable to fail structurally under heavy loading. It might be interesting to remark that there is one critical load for each size tire and for each speed where the cushioning is most pronounced; that is, a lightly loaded tire will bounce and thereby exaggerate vibration; on the other hand a heavily laden tire will show less response in cushioning due to its already highly distorted condition. Tires are similar to springs in this respect.

RELIABILITY

The reliability of a solid tire in performing its functions needs very little comment. It is listed as one of the commercial properties because it is a property which is of considerable importance to truck operation as a whole. In the case of truck tires this property is practically entirely dependent on the tire details themselves.

SERVICE COST

The remarks concerning reliability apply equally well as to service cost; in addition there is of course the question of attention on the part of the selling house.

TRACTIVE GRIP

The effectiveness of the traction of a tire is dependent on the coefficient of friction between the tread rubber and the road surface. Consequently compound, width, weather (wet or dry), loading and the character and condition of the road surface are the principal elements affecting traction. On dry surfaces there is no advantage to be found from the use of a notched or broken tread over the use of a continuous tread, for in either case the grip of the tire is dependent on the simple phenomenon of friction between the rubber and road surface. Wet or greasy pavements are well known to be annoying and often dangerous. The coefficient here is exceedingly low, ranging from .11 to .15 or .20, whereas it would be from .50 to .60 on dry pavement. I believe that under certain conditions the coefficient of friction between the tire and the surface can be greater than 1.00. This seems conceivable in the instance of a soft yielding tread compound on a firm rough surface.

WEAR AND FAILURE

So far nothing has been mentioned about the ways in which tires wear out or fail. This should be outlined briefly as several of the commercial properties are directly dependent on the wearing qualities of the tires. You will notice that the various items under each main subdivision are enumerated as forms of legitimate wear or as forms of abuse. The significance of this is suggestive rather than absolute, the idea being to convey the distinction which one would observe in the case of perfect service.

A—Abrasion of tread rubber, due to

1—Tractive effort 2—Natural wear of rolling friction 3—Skidding	Legitimate wear
4—Spinning wheels by quick starts 5—Sliding with brakes set 6—Wheels out of alignment	Abuse

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B—Cutting, chipping, or spreading of tread rubber, due to	
1—Sharp stones, glass, etc.	Legitimate wear
2—Poor road surfaces in general	
3—Car tracks	Abuse
4—Use of anti-skid devices	
C—Disintegration or deterioration of tread rubber, due to	
1—Sun and heat	Legitimate wear
2—Allowing tires to freeze	
3—Oil on garage floor	Abuse
4—Heating by excessive speeding	
D—Failure of the tire structurally, due to	
1—Overloading	Abuse
2—Speeding	
3—Shocks and impacts from reckless driving over uneven road surfaces	

E—Premature failure or wear due to imperfections of manufacture.

The foregoing is an exposition of the relevant elements entering into the determination of the proper tire sizes. This method of elaborating on the situation is apt to leave the inference that the situation is so hopelessly complicated that there is nothing in particular to be done except make the best of it. On the other hand, I realize that there are many who, although they will not dispute the truth of the facts presented, will be tempted to depreciate their significance, preferring to dispose of the matter by insisting that "tires are tires" and that it is up to the tire companies to produce the goods. Before us is a summary of the items by which the service performance of the tires are judged and an exposition of the factors on which these various items depend, and finally the possibilities to be taken advantage of in the way of attempting to regulate the tire problems toward more satisfactory ends. You gentlemen know to what extent operating conditions can be controlled and regulated. As for tire details those having a knowledge of tire design and manufacture realize that with proper attention to compounding and fabrication methods a wide variety of constant results is possible. I wish to bring out one point very emphatically, however: While it is possible to alter tire details so that results shall vary through a wide range, it is also true that if these details be altered with the idea of highly perfecting one commercial property, this may be at the sacrifice of some other property or properties of nearly equal importance.

What does the motor truck industry want as qualifications for a satisfactory motor truck tire? In other words what is the relative importance of the commercial properties? Are we getting all the cushioning effect desirable consistent with economy of truck operation? Should not more stress be laid on the property of power consumption for the ultimate benefit of economic truck operation? How much should we sacrifice in the cost per tire-mile property and the durability to balance the other properties for the good of economical truck operation? Manifestly all are not of equal importance. For instance if the cushioning effect be highly developed with the idea of decreasing the truck repair expenses by lessening the destructive vibration, this much is certain, the tread rubber will necessarily be of a soft yielding compound in

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such an idea. But we will find the cost per tire-mile increased and the durability diminished very materially unless we diminish the load which the tires carry, which in turn will raise the ton-mile cost of truck operation. To a slight extent, with the introduction of additional cushioning effect, the resiliency and tractive grip may or may not be altered.

If the stiffness or plasticity of the tread rubber of the various brands and types of tires be compared, it will be found that there is a wide variation. In spite of this, well-known makes of trucks in any locality, equipped with competing tires which exhibit these marked differences, will be found running side by side. Surely so important a property as that of cushioning effect should be more or less uniform under similar conditions. I often ask engineers, owners, and drivers whether they want a hard stiff tire which will give almost no cushioning to the truck, or a tire which will protect the truck even if the tire-mile cost is a little higher. Some have never given the idea any thought, some (users particularly) do not care anything about the tire so long as it wears, some are looking for information, and a few have such decided convictions in favor of proper cushioning effect that they will not use solid tires of any description and choose the more expensive pneumatic.

This illustration of the relations between cushioning effect and the plasticity of the tread rubber is typical of a multitude of combinations of properties and conditions which might be portrayed. It would be an endless and wearisome task to enumerate and discuss all these combinations.

At the present time the formalities of truck tire merchandizing are limited to a guaranty of perfection in workmanship and a certain maximum cost per tire-mile. Also, each tire company has its own special list of permissible loads which each size of tire may carry. Without dwelling on the shortcomings of this happy-go-lucky method of dealing in tires, permit me to call to your attention that in the iron and steel world it is customary to buy and sell material which fulfills the requirements of certain chemical or physical specifications. The art has been perfected to such an extent that the measurement of the elemental subdivisions is now a matter of every-day routine in the up-to-date office, and moreover it is recognized that buying on specifications is the only sane policy—fair to both purchaser and seller. Standardization is not by any means limited to steel; Portland cement, paints, chemicals, electrical apparatus, boilers, etc., are all more or less thoroughly standardized.

In outlining the solid tire situation I have proposed an equation representing a balancing condition between the results which the tires give in service on one side, and the details of the tires themselves, the cost of marketing, and the conditions under which they are used on the other. By developing this equation in detail I have attempted to emphasize:

1st. The complexity of the solid tire problem due to the innumerable variables into which the whole may be sub-divided.

2nd. The importance of recognizing that economy of truck operation in its broadest sense should be the guiding motive behind any solid tire considerations.

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3rd. The fact that the performance of solid tires in service has never been given the proper attention in the matter of criticism from the angle of economic truck operation as a whole.

4th. The logic of recognizing the "commercial properties" and the desirability of discovering their relative importance.

5th. The limitations encountered in bringing about ideal conditions due to practically positive inability to regulate or control the operating conditions which are included under road surfaces, topography, weather, and driver.

6th. The facts that the solid tires are still capable of considerable development and that this development is essentially a process of evolution and elimination; also that there are certain practical limitations in the production of the tires themselves which permit the attainment of high degrees of perfection of certain commercial properties only at a sacrifice of others.

CONCLUSION

In conclusion I simply venture a general summary. The ideal disposition of truck tire standardization would be to prescribe standards of commercial properties to be attained when the tires are in service under standard road surface conditions; the variables under this scheme would be the tire details. However, inasmuch as it would be impracticable, to say nothing of being cumbersome, to test each tire for the values of the commercial properties, to determine whether they come up to standards or not, it would develop that once we have arrived at and defined a satisfactory condition in the matter of service performance, the simplest proposition would be to take cognizance of the physical properties of the tires themselves and standardize them together with the loadings, speed, and spring suspension.

Introduction of Discussion for Summer Meeting.

THE IDEAL CAR

By Charles Ethan Davis *

(Member of the Society)

The future car for economy, luxury and business purposes will, in my judgment, be constructed with the following general specifications:

DESIGN

The car will have a harmonious streamline effect, utilizing substantial materials in body, fenders, bonnet, radiator and wheels, combined in such a way as to eliminate molded surfaces, sharp corners, dust-pockets, projecting hinges and handles; the head-, side- and tail-lights and horn being blended into the general outline, the tool-box, tire- and luggage-

*Advising Mechanical Engineer.

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carriers concealed in dust-proof compartments provided for in the body design. The wheelbase should be 128 to 132 inches for cars accommodating two to five persons.

WEIGHT

The car filled with gasoline, oil and water should not weigh over 2,750 pounds. This can be accomplished without reducing the factor of safety below absolute security by employing a large percentage of pressed steel parts properly designed.

STABILITY

The center of gravity should be low and as near the center of car as possible, the weight being carried between axles.

MOTOR

A four-cylinder valveless motor, 3¾ x 5½ inches, carefully constructed to give reliable, economic service under all conditions, at speeds varying from 200 to 3,000 r.p.m., and developing at least 60 B.H.P. at 2,500 r.p.m. (No type of motor barred.)

CARBURETER

Optional. Sealed type desirable. To be located on left side of motor, close-connected and properly water-jacketed. If adjustable, dash or steering post regulator to be used.

CHASSIS

To be low, not over 19 inches from floor line to top of frame, with a road clearance of 10½ inches; frame of pressed steel electrically welded, without side bends and designed to house rear, cantilever springs. A dust-guard under entire length to reduce wind resistance and dust raising.

WHEELS

Thirty-six by four and one-half-inch wire wheels with quick detachable rims, using either extra wheel or shoe as desired.

BRAKES

Two sets: as service brakes, one set of internal brake-shoe type to act on all wheels to avoid skidding; one set internal brake-shoe type to act on rear wheels, only for emergency. Brake drums to be covered and as nearly dust-proof as possible. All adjustments to be outside and easily accessible.

SPRINGS

Forward springs semi-elliptic and rear springs cantilever, all with wide, thin leaves to insure flexibility and easy riding. (If shock-absorbers are used, they must have a time element to take rebound, but be inactive on down movement.)

FRONT AXLE

Sheet metal design, including steering knuckles and connections; central pivot knuckles, preferably of castor type.

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REAR AXLE

Sheet metal design, worm-gear drive, 3½ to 1 ratio, with worm under axle. Torque and drive to be taken through tube with large end-thrust ball; leather or rubber disc universal connection to propeller-shaft, with suitable rod connections to insure proper spring action. The axle to be so constructed that thrusts for worm and gear are permanently fixed and at the same time easily dismountable for inspection. Total unsprung weight of rear axle, 200 pounds.

GASOLINE AND OIL TANKS

To be located in dash cowl, with filling openings outside the car and easily accessible. Gasoline tank for pressure system to be divided, one part high for gravity feed on hills or starting in case pressure fails. Tank to be so vented that evaporation odors will be eliminated.

STEERING GEAR

Standard worm and gear, locking type; cross steer preferred and adjustable to any desired angle.

TRANSMISSION

If mechanical, four or more speeds forward and one reverse; either silent chain or gear. A new petrol-electric transmission will give at least ten speeds forward, one reverse. It will also have a charging section and serve as a starting and lighting outfit, operating in connection with a standard storage battery.

CONTROL

If mechanical, a single rocking central lever located well forward. A better method would be pneumatic or electric, operated by buttons. If petrol-electric transmission is used, a control box located on the steering post and designed to carry horn and light buttons is easily available.

RADIATION

Thermo-syphon with liberal radiator and piping.

MAGNETO

High-tension.

STARTING AND LIGHTING

The future type will be a flywheel combined generator and motor without revolving wires, requiring no auxiliary driving mechanism and capable of being easily assembled, combined with a magneto connection similarly operated.

LIGHTS

Two side-lights artistically mounted on fenders and movable to light sharp turns of the road. One tail-light on rear fender to light rear number plate. One centrally located head-light, having a deflector to either dim or turn light in either direction to insure safety from glare when in city or meeting cars on the road; and with a provision for lighting front number plate.

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HORN

To be mounted well forward either under or attached to fender and operated from steering-wheel.

ELECTRICAL CONNECTIONS

To be vari-colored wires or bars, thoroughly protected, easily mounted, and traced by means of tool-box chart.

SPEED INDICATOR

To be carefully housed and driven from propeller-shaft, with double dial, one for driver and one for rear seat.

TOOLS

Under front seat on driver's side.

TIRES AND TUBES

To be carried in dust-proof compartment in body behind rear seat.

BODY

To be designed on streamlines with fender, bonnet and cowl in harmony. Wide doors, deep, low seats, French style of upholstery or air cushions, with plenty of room for long-geared people. Luggage to be carried under passenger's side of front seat, back of front seat and under rear seat in easily accessible, dust-proof compartments. No boxes or racks on outside of car or on running-boards. Concealed hinges and handles to insure a smooth outline.

TOP

To be a one-person-operated disappearing design to close tight for winter.

BONNET

To be of the inside concealed hinge variety similar to the Alexis Kellner design.

WIND-SHIELD

Vented, curved glass to conform to the cowls in such a way as to prevent back or overhead drafts.

SPEED

Car to be governed to a maximum speed of 50 miles per hour, and for touring purposes 25 miles per hour, and adjusted to operate on direct gear in city work down to four miles per hour and to pick up to maximum governed speed in 100 to 150 feet. With a four-speed mechanical transmission direct on third, third speed should cover all ordinary hills. With petro-electric transmission change of speed and power can be made without releasing clutch, and all changes are noiseless.

NOISELESSNESS

This is best obtained mechanically with valveless motor, silent-chain transmission and worm-gear axle. In petrol-electric transmission with valveless motor and worm gear axle.

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DURABILITY

The above combination, well cared for, should give eight years' satisfactory service so far as the mechanism goes, and easily cover 120,000 to 150,000 miles, tires of course excepted.

ACCESSIBILITY

The same careful study should be given to all details of the design that is applied to all machine designs. All parts should be easily accessible and removable with the simplest possible tools, either on the road or in the garage, and with no possibility of damage to upholstery or finish. All adjustments of brakes, carbureter and magneto to be easily reached.

EFFICIENCY

This is largely up to the driver. With careful handling I think an average of twenty miles per gallon can be easily maintained.

VIBRATION

If the car is properly built there will be no unpleasant vibration or noise to cause fatigue, even on the longest journeys.

IN GENERAL

The car ought to be marketed at a price not to exceed $1,500 and be good commercially from manufacturing, efficiency, economic, service and sales standpoints.

Read before the Detroit Section.

ELECTRIC GEAR-SHIFTING.

ELECTROMAGNETS

BY CHARLES R. UNDERHILL*
(Associate of the Society)

The elementary action of electromagnets in general may be described briefly as follows: Connect a straight electrical conductor to a source of direct current, such as a battery, and current will flow through the conductor. Around this conductor will then exist a magnetic field of force at right angles to the axis of the conductor, due to the current in the conductor. By forming the conductor into a circle, the magnetic field is intensified, since all of the magnetism must pass through the ring or loop

*Consulting Engineer, Acme Wire Company.

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of current in the conductor. Calling the magnetic field "flux," we say that the flux density is increased by looping the current-carrying conductor. By winding several loops of conductor, side by side, and with a common axis, the density of the flux is increased. Such a helix of current-carrying conductor is called a *solenoid*. The windings of solenoids generally consist of many layers of insulated copper wire, each layer consisting of a helix of many turns. The physical dimensions of the wound coil, together with the cross-section of the conductor, determine the magnetizing force generated and the power consumed in generating this force, in the solenoid, per unit of applied e.m.f. The presence of iron in the core hole of the solenoid increases the flux, since iron is a better magnetic conductor than air. In other words, an iron core surrounded by a coil of wire through which current is flowing will have therein a great many more times as much flux as will the air core of the coil only. Such a coil of wire with an iron core constitutes a bar electromagnet, and from this simple bar electromagnet are evolved all of the commercial types of electromagnets. For instance, if the iron core be free to move and current is flowing through the winding, force will be required to withdraw the iron core from the coil. This constitutes a simple solenoid and plunger.

If the core be fastened rigidly within the coil, and with current flowing through the coil, ferric materials will be attracted to the core, but with relatively small force, owing to its so-called open magnetic circuit. In order to obtain a very strong pull through a very short distance, we bend the core and coil into the form of a horseshoe when we obtain a horseshoe electromagnet, which may be made in many ways. This horseshoe electromagnet is particularly adapted to holding a load, since, when the armature is placed across both pole-pieces of the horseshoe electromagnet, the magnetic circuit is completed, which causes the magnetic circuit to possess a low reluctance or magnetic resistance and permits a larger flow of flux, thus giving the magnet great attracting power. If, however, the armature is separated for even a comparatively short distance from the pole-ends of the cores, the pull will be found to be exceedingly weak. In other words, this type of electromagnet is not suitable for heavy duty through a considerable range of action or stroke. If there was no magnetic reluctance in the magnetic circuit of the horseshoe electromagnet, excepting in the air gap, the pull in the air gap due to the contraction of the flux, would vary inversely as the square of the length of the air gap. However, there is always some reluctance in any magnetic circuit, so that the maximum pull between any two attracting areas occurs when the reluctance of the air gap is equal to the sum of the reluctance of all other parts of the magnetic circuit.

For a long pull and a strong pull, the solenoid and plunger are employed. The action of the solenoid is as follows: Consider a simple coil of wire with current flowing through it and with one end of the iron core or plunger approaching one end of the core-hole of the coil. As the iron core comes within the magnetic field of the solenoid the iron core becomes magnetized by induction, which really means that the presence of the iron in the magnetic circuit of the solenoid decreases the reluctance of the

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magnetic circuit at this point; but right here is a good place to mention the magnetic circuit of the iron bar which is now partly magnetized. Consider only the part of the iron bar which is within the coil and let the iron bar project any distance whatsoever inside of the coil. Then half of the iron core which is inside of the coil will be of north-seeking polarity and half will be of south-seeking polarity. One might think that the magnetic field of this core would be very weak, but when it is considered that the reluctance of the air or ether surrounding the core is proportional to the average length of the magnetic circuit through it divided by the average cross-sectional area, it is seen that the average length of the magnetic circuit through the air or ether will be somewhat less than the length of core inserted into the coil; whereas, the cross-sectional area will lie somewhere between zero and infinity. Calculations from actual tests made by the author have shown that this reluctance approaches unity in many cases, so that it is possible to have a large amount of flux flowing through the core of the solenoid although the only return circuit is through the medium surrounding the core.

It should be remembered that the magnetic field due to the current in the coil and the magnetic field of the core are two separate and distinct fields, and that it is the attraction between these two fields which causes the plunger to be drawn inside of the coil; all attraction ceasing when the magnetic center of the plunger reaches the magnetic center of the solenoid. The shape of the pull curve may be roughly compared to a part of the sinusoid, as shown by curve *A* in the figure. The plunger becomes more and more magnetized as it passes inside the solenoid until it reaches the point where the pull is maximum; then, as the magnetic centers of the coil and core approach one another, the pull falls off because there is an apparent repulsion. Now, in magnets of the horseshoe type the pull curve approaches that of the rectangular hyperbola as shown in curve *B* in the figure. In other words, the pull keeps getting stronger as the armature approaches the polar faces of the core. It is seen, then, that by combining the solenoid and horseshoe magnet in such a manner that just as soon as the solenoid pull begins to fall off, the horseshoe magnet will take hold so as to keep the curve up, as in curve *C* in the figure, which is the sum of curves *A* and *B* and represents the total pull curve of a plunger electromagnet, a pull may be obtained which will be strong at the beginning of the stroke and stay strong throughout the entire stroke. This is commonly accomplished by surrounding the coil of the bar electromagnet with an iron frame; separating its core into two parts, so that one part shall remain fixed within the coil and to the iron frame, and the other part, known as the plunger, shall be free to move and carry the load.

The length of the fixed part of the core, which is called the stop, varies for different plunger electromagnets, depending upon the degree of magnetization in the core; the physical dimensions of the ferric parts; physical dimensions of the winding; and the length of the stroke. In some cases the best results are obtained when the stop projects approximately one-third into the coil; whereas, in an exceedingly short

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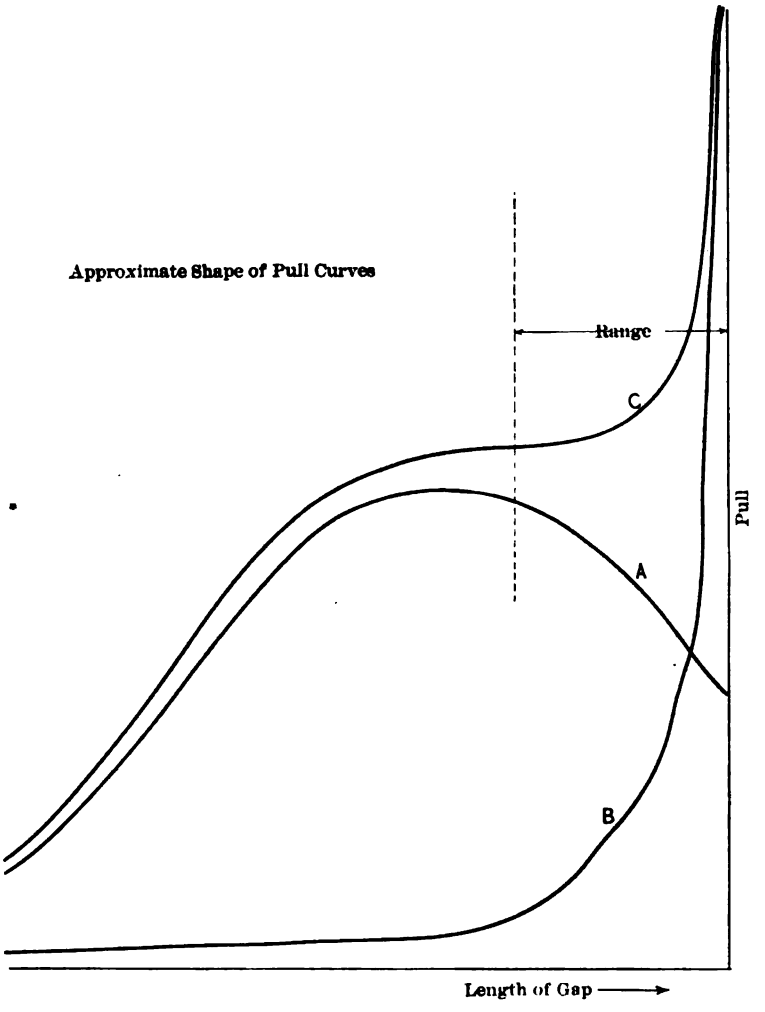
solenoid, the best results are obtained when the stop is entirely outside of the coil. In the type of solenoid used in the electric gear-shift the end of the frame surrounding the coil acts as the stop or attracting area, which keeps the pull up after the solenoid pull begins to fall off.

The winding of the electromagnet is very important, because, having ascertained the necessary physical dimensions of the magnetic circuit, it is necessary to supply sufficient electric energy in order to properly magnetize the magnetic circuit so that the proper output may be obtained.



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The ampere-turns vary directly with the voltage across the terminals of the coil and inversely as the resistance of the average turn of wire. It is, then, important to get in as much copper as possible, since the cost of operating will vary inversely with the amount of copper contained within the coil. The total amount of copper in the coil is not only limited by the physical dimensions of the coil, but also by the amount of insulating material which is placed around the wire and within the coil. It is, therefore, desirable to keep the insulation on the wire as thin as possible, but it also is necessary that it shall be mechanically strong and chemically inert and such that it can be reinforced by some insulating varnish or compound, after the winding process, to keep out the moisture; and it must not be affected by mineral oils, etc. For this purpose, the coils used in the electric gear-shift are wound with round copper wires having, first, a coat of enamel, which is inert to all the ordinary chemical reagents, and unaffected by mineral oils, even at very high temperatures. The wire is next covered with a coat of cotton for mechanical protection, and as a holder for the filler which is subsequently put into the coil. These coils are form-wound on automatic winding machines of special construction, so arranged as to quickly and accurately produce coils uniform as to greatest permissible tension on the wire, which insures maximum turns, uniform resistance and dimensions of the wound coil. The coils are then supplied with heavy leads, the cross-section of which is greater than that of the wire in the coil in order to prevent excessive loss of energy in the leads. The splices to the leads are soldered and covered with oiled muslin, and protected with fiber to prevent mechanical injury and also any sharp corners or the points of the soldered splices coming into contact with the wire in adjacent turns. The coils are next thoroughly dried and then placed in clear insulating varnish until they are thoroughly impregnated. They are then baked in an oven for a period of thirty-six hours. After the coils are thus treated they are unaffected by moisture or oil.

CURRENT CONSUMPTION

In recent tests made by W. A. McCarrell and the author, on a car equipped with the electric gear-shift, it was found that the average current consumed per shift was 43 amperes, but that the duration of this current was less than one-third second, so that it is possible to obtain approximately 300 shifts per ampere-hour, or, on a 12-volt system, the equivalent to 300 shifts per 12 watt-hours, or 25 shifts per watt-hour.

When an e.m.f. is first applied to a solenoid with an iron core, the core is slightly magnetized, but the rate of change in the magnetic flux in the core produces a counter-e.m.f. in the solenoid, so that the complete magnetization of the core and the maximum current in the solenoid are not attained at once, the time depending upon the physical dimensions of the solenoid, core and conductor. The current-time curve is logarithmic, so that the actual energy consumed in one-third second would be nearer one-half of the values mentioned above; hence, the shifts per watt-hour would be nearer 50. On this basis the shifts per kilowatt-hour would approximate 50,000. This is due to the fact that

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the current is on but for a brief period, owing to the construction of the switch mechanism of the gear-shift. This particular magnet has a pull of 48 pounds through 1 1/16 inches, with 12 volts and 50 amperes, or 600 watts. The plunger is one inch in diameter. On other coils with 1¼-inch plunger a pull of 50 pounds is obtained through 1 1/16 inches with 6 volts and 66 amperes, or 396 watts. In general, the higher the voltage applied to a coil of fixed physical dimensions, the finer must be the wire and the less the insulation on the wire. However, for the coarser sizes of wire, there is practically no difference in the ratio of copper to wire insulation, so that a coil wound for 12 volts is just as efficient as one wound for 6 volts.

The foregoing shows the importance of correct design for electromagnets in general. The application of electromagnets to electromechanical devices is becoming so general that special designs are required in nearly every case of application. For instance, the diameter and length of the plunger; the position of the air gap inside of the coil; length of the coil; mean length of turn; proper radiating surface, etc., are all dependent upon specific conditions under which the electromagnet is to be used. In general, these conditions may be classified as voltage; initial pull; shape of the pull curve; length of stroke; rapidity of action; character of load to be moved; number of operations per unit of time, etc. The insulation on the wire and between the wire and the containing spool or frame will also depend upon the character of the electromotive force employed. In any case it is necessary to provide ample insulation so that the volts per layer, or rather electromotive force between any two layers, shall not be excessive. It is thus seen that the proper design of an electromagnet to perform a specific duty is an engineering problem which should, in every case, be worked out on the most economical lines in order that the maximum output may be obtained for the minimum input. Stress is laid upon this fact for the reason that within the years of the author's experience in designing and constructing electromagnets and coil windings for many purposes, it appears that the customer generally considers the electromagnetic part of his device as a minor matter and seldom chooses the proper type. This is, of course, natural, when the customer is more familiar with the mechanical device than the electrical. As a rule, more space is required for the electromagnet than is allowed for by the designer. This is partly due to an incorrect understanding of the design of the magnetic circuit, but more often due to an improper amount of radiating surface for the coil.

RELIABILITY

To increase confidence in the matter of shifting gears by electromagnets, I wish to state most emphatically that, in my opinion, these magnets will operate satisfactorily during the life of the car. You have electromagnetic control at every step. Your door bell is rung by coils. Do the coils fail? The electric elevator is started, accelerated, and stopped by solenoids. The most modern signals on railroads and trolleys are operated by electromagnets. The doors are opened and closed by solenoids. The automatic elevators and dumb-waiters are controlled

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by push buttons and solenoids. The heating of trolley cars and office buildings is automatically controlled by solenoids in connection with thermostats. Consider the enormous field of the telegraph and telephone. Can you imagine anything that has to be more positive and fool-proof than these systems? Yet they are absolutely dependent upon electromagnets. In our manufacturing plant, we use solenoids and plunger electromagnets to reverse automatically the traverse of the winding machines, because we can reverse the direction of the carriage at points which do not vary even 1/64 inch from the designated position.

A SPECIFIC TYPE

By W. A. McCarrell*
(Member of Society)

About twenty years ago appeared what was termed the horseless carriage, a crude affair which during its development was an object of ridicule. Few outside of those sturdy pioneers of the industry could see a future for it and it is doubtful if they pictured in their wildest dreams the great industry which the automobile business is today. Developments went forward. The crude "one-lunger" passed and the four-cylinder car appeared in our midst. Steels were refined to their present state of excellence. Frames and springs were perfected. Clutches and universal joints were developed; axles and transmissions were constantly improved. The lines of the body and its comforts were given every attention until with the coming of the sweet-running six-cylinder car it seemed that the point of perfection was reached. Then came the motor starter; the crank went into the tool box. The drive was changed from right- to left-hand, the control from side to center, but there remained the cumbersome and unsightly gear lever.

The electric gear-shift has been developed during the past six years. We designed devices for shifting gears mechanically, electrically and with compressed air. The problem presented divided itself into several parts. In order to change gears automatically there must be some means for shifting them, some selective mechanism for determining which gear is to be shifted, and provision for preventing the shifting of gears when the clutch is in engagement. Having in mind the ultimate use of electricity for starting and lighting, we progressed electrically.

One of the original ideas was a device which would not only draw the gears into mesh electrically, but neutralize electrically as well. This, of course, added considerable wiring complications, and was not as dependable as desired. Another development condensed into a simple compact device wherein the gears are drawn into mesh by a solenoid or electromagnet, and positively drawn to a neutral position mechanically before another gear can be shifted. In a nutshell, the Vulcan electric

*Chief Engineer, The Cutler-Hammer Manufacturing Company.

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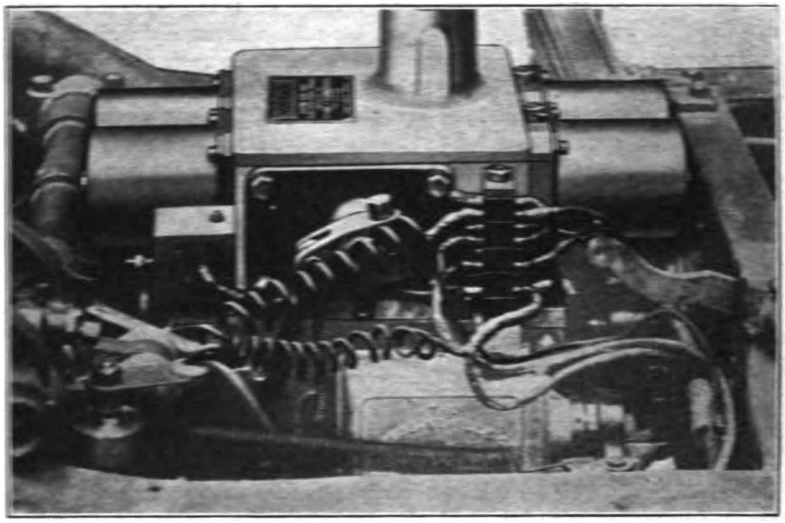

Electric Gear Shift. Showing right side and neutralizing cam.

gear-shift is composed of a case which bolts directly on the top or side of a transmission, and contains or carries a solenoid or electro-magnet for each speed in the transmission; armature or magnet cores carried by these solenoids, which cores, in turn, carry the forks which engage with the gears in the transmission; a master switch common to all speeds, for closing the circuit after the gears are drawn to a neutral position by the neutral cam; and a selector switch containing a plainly marked button for each speed, and neutral, by means of which the next shift can be selected at the driver's convenience.

The solenoid for each speed in the transmission, when energized, attracts the magnet core or armature which carries the shifter fork, and the gear is carried into engagement. This unit is composed of a cast iron washer into which a brass tube or coil carrier is pressed, and serves as a bearing for the magnet core. A properly wound coil is then pressed on this tube and a pressed steel case placed over it, which not only protects the coil from injury but completes the magnetic field. The units are then securely bolted to the gear-shift case, one for each speed that may be desired, and so arranged that two of them come directly opposite each other front and back, so that the pair carry a magnet core. These magnet cores or armatures are round pieces of steel of such length as to allow a clearance at each end equal to the movement of the gear from a neutral position to full engagement, plus a slight clearance to avoid the possibility of the core striking the end of the solenoid when the gear is drawn into mesh. On each of these cores we provide three notches, one for the interlocks at neutral and the other two for position locks. These interlocks and position locks which engage the

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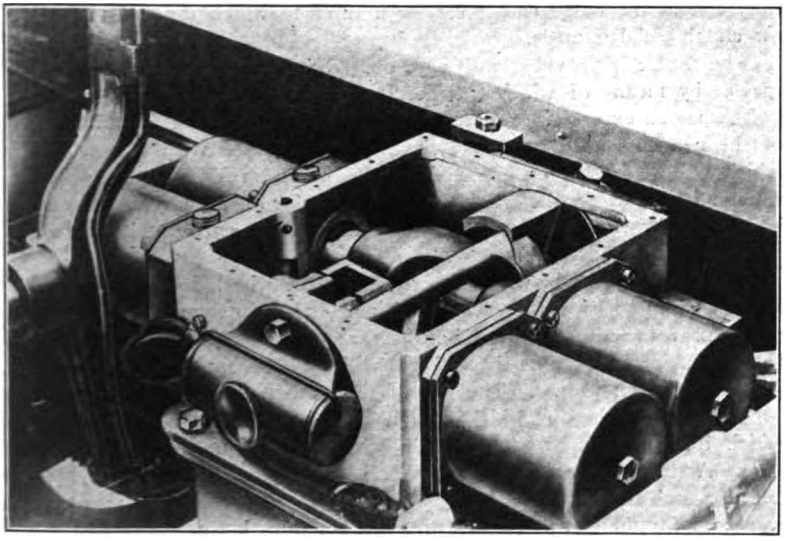

Electric Gear-Shift. Left side.

magnet cores are carried in the cast iron washer at the end of the coil, the position locks being on the top with the interlocks working between, replacing the usual transmission interlocks. It is impossible to engage another gear while one is in mesh. In addition to the interlock notches, the magnet cores each carry securely fastened to them a fork engaging with a sliding gear in the transmission, and carrying it into mesh when the magnet core is attracted one way or the other. On these forks are provided lugs which engage with the neutral cam when the gears are being drawn mechanically to a neutral position.

Next is the neutral cam, or neutral rocker-arm. This is a rectangular-shaped piece of forged steel, through which the magnet cores pass, and which works on either side of the same in drawing the gears out of mesh. One end of this cam rests in the barrel-shaped bearing on the side of the shift. Two opposite sides of the male portion of the bearing are milled flat at an angle from the perpendicular; when these flats are perpendicular the cam proper stands at an angle, what we may call its normal position, one-eighth of an inch from its total throw. This is accomplished by means of springs, which operate in sliding sleeves in the barrel-shaped portion of this bearing, one on either side, and which balance each other, and in working against the flat on the end of the neutral cam, return it to the normal position when released. The bearing at the other or operating end of the cam lies within the bearing of the operating end, which in turn is carried in a cast iron bearing bolted directly to the side of the gear-shift case. This operating end carries a small dog, which drops into engagement with a shoulder on the neutral rocker arm to pull any gear which may be in mesh to its neutral posi-

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tion, and at the outer end it carries a lever to which the connection to the clutch pedal is made.

The device is provided with a laminated master switch common to all speeds, by means of which the circuit is either closed or broken. This switch has an extension or shaft which enters the case and passes the end of the neutral rocker arm, said shaft being provided with a notch, into which a dog carried on the end of the neutral rocker-arm drops for engaging the switch, the whole being provided with a carrier or bearing bolted directly against the end of the case. The entire master switch may be removed as a unit.

The selector switch, which is carried on the wheel, is composed of a series of buttons, one for each speed, and one for neutral which has no electrical connection. These buttons are provided with arched laminated contacts of copper backed up with a steel spring and insulated from the button proper. The top of the switch carries a locking plate for locking any button which may be depressed, and also an interlock which makes it impossible to hold down more than one button at a time. At the bottom is a hard-rubber base which carries a copper contact for each button and a contact common to all speeds. It also serves as a base for the return springs provided for each button.

The wiring is extremely simple. There is one lead passing from each coil through a terminal block to its particular speed button on the selector switch, while the other lead from the coil is joined to a neutral wire directly through the terminal block to the battery, with the master switch intervening, while another wire passes through the terminal block to the contact on the selector switch, which is common to all speeds. You can, therefore, very readily follow the flow of the current, the same being from one end of the battery through the speed contact on the selector switch, down and around the coil selected, returning through the wire to the other end of battery.

The terminal block is carried on the shifter case to afford convenience in removing the transmission without disturbing the wiring, and is composed of a male and a female terminal for each speed, which are separated from each other by fiber blocks, all being securely clamped together by one through-bolt. These terminals are each of a different size so that should it be desired to pull the wires out, there is no danger of getting them mixed.

OPERATION

Let me impress upon you that the buttons may be pressed at any time without effect, as current is drawn only when a button is down and the clutch pedal fully depressed. When it is desired to start the car, the first-speed button is pressed until it locks. The clutch pedal is then fully down, thus closing the master switch; the coil is energized and the gear is instantly drawn into mesh. Letting in the clutch, the car moves off as usual. Another button may then be pressed without drawing current or affecting a gear already in mesh. When the speed-change is desired, the clutch pedal is depressed, pulling by interconnection on

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the operating lever, which turns the above-mentioned operating end, which carries the dog engaged with the neutral rocker-arm, causing it to turn and pull against the shifter-fork of the gear already in mesh, taking it to a neutral position. As the gear reaches neutral, the dog is tripped out, and the neutral rocker-arm flies back to its before-mentioned position. ⅛ of an inch from the total throw of the gear. As this rocker-arm is moving forward, the small dog which it carries drops into the aforesaid notch on the stem of the master switch, engaging same, and as it snaps back, carries the master switch into engagement, closing the circuit, when the gear selected instantly jumps into mesh, and when within ⅛ of an inch from being home, strikes the neutral cam, which kicks out the master switch, and the gear carries through of its own momentum; the action being the same for all speeds. When desiring to stop, the neutral button is pressed, which breaks any connection in the selector switch, and the clutch pedal is fully depressed, drawing the gear in mesh to neutral.

One of the beauties of the device is the ability to anticipate the next gear change; that is, when driving in one speed another button can be kept down, and when occasion arises all that is necessary in order to change gears is to throw down the clutch pedal, the hands never leaving the wheel.

You all know that the greatest damage is done to gears when an effort is made to jam them together without fully releasing the clutch. Our magnets are designed to produce a minimum pull of 40 pounds at a distance equal to the throw of the gears, commonly an air gap of 1 1/16 inches. As the gear moves into mesh and the air gap decreases, it is, of course, understood that the magnetic pull increases very rapidly until at an air gap of ¼ inch the coils show a strength varying from 150 to 180 pounds. Should the gears fail to engage instantaneously, therefore, at an air gap of 1 1/16 inches, the magnetic strength is not sufficient to produce any damage, even though a grinding noise is heard, for as the gears time themselves to the proper speed and finally mesh, the magnetic pull increases so rapidly that a full engagement is assured.

No damage can be caused if the throw from high to reverse, or high to first, should be attempted at any speed of the car, for the gears cannot possibly mesh until they have been brought to their proper time ratio. On a test car in Philadelphia throws have been made from high to reverse and high to first at extreme speeds on an average of 50 to 100 times a day for the past year and a half, and the gears allowed to grind for periods ranging from a minute to two and three minutes at each throw without the slightest damage to the transmission. The original transmission is still in the car. While it seemed at first impossible that the transmission would not be absolutely wrecked, an examination of this original transmission made recently failed to show the slightest injury.

You, of course, understand that in driving the clutch pedal may be depressed and the clutch slipped as usual; the action of the clutch pedal

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being, first, to release the clutch, then to neutralize the gear in mesh, and finally close the master switch.

It may be of interest to know that in a recent trial with a stock car I was able to shift back and forward from second, third and fourth speeds thirty times in twenty seconds, holding the car at fifteen miles an hour.

The electric gear-shift can be adapted to any electric starting and lighting system, irrespective of the voltage; the magnets are wound to suit conditions. Higher voltage, of course, means less amperage, less losses, and permits the use of smaller wires. We find that the best results can be obtained on generating systems with voltages of 12, 18 or 24.

APPLICATION

By Frank N. Nutt*
(Member of the Society)

The chief objection to the hand-shift method is, in my opinion, that it is not fast enough to take care of the relative speed between the car and the motor. This may be determined readily anywhere at any time. Watch for a few minutes automobiles start off and listen to the noise which invariably accompanies the shifting of gears. This noise is more or less dependent upon the action of the clutch and the skill of the driver. It does not signify that the clutch is at fault, nor that the method of changing gears is crude, but that the hand-shift method does not provide an efficient means whereby the average driver can shift gears noiselessly.

The electric gear-shifting device possesses a great many more features than merely that with its use the driver can shift gears silently and smoothly at all times, but to me that is the paramount feature. In the fall of 1911 I first learned of the various devices for shifting gears automatically, and was immediately interested. During the 1912 New York Automobile Show I had an opportunity of seeing and operating one of the Vulcan devices. I was very favorably impressed with the silent manner in which the gears were shifted, thus overcoming my chief objection to the hand-shift method, and also with the rapidity with which shifts were made. I traveled around the city through its most congested districts, finally taking the wheel myself and shifting repeatedly from one speed to another. The manner in which the car responded led me at that time to believe that the question of gear-shifting had at last been satisfactorily solved—a point on which I am now thoroughly convinced. The first device for the Haynes car was built specially for the reason that I wanted it sufficiently high to clear the clutch-operating mechanism and cross members, to enable me to experiment with different sized coils, and in this way ascertain the proper pull for

*Chief Engineer, Haynes Automobile Company.

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satisfactory shifting. Originally the solenoids were wound for a twenty-pound pull with 1 1/16-inch stroke. Testing proved, however, that a forty-pound pull with the same stroke was more satisfactory, the question of heavy lubricants, which become thickened in cold weather, governing my decision in this matter to some extent. The next step was to secure a satisfactory mechanical connection between the clutch pedal and the neutralizing cam of the gear-shift, which practically necessitated re-designing the gear-shift to insure simple and positive mechanical engagement and operation. After the work of re-designing was completed, the gear-shift unit took the place of our standard transmission lid and eliminated all shift-rods, forks and interlocking devices previously used in connection with the hand-shift method, as these parts were embodied in the gear-shift itself.

There is no question but that the use of the electric gear-shift eliminates the possibility of wearing and stripping of the gears, due to the fact that it is absolutely necessary that the clutch be all the way out before the gear-shift will act. The very principle of the device overcomes the possibility of stripping gears. Besides driving my own car daily to and from business, I have made extensive trips all over the Middle West. This car is not equipped with an auxiliary hand shift and never has been. I have had no occasion to even raise the floor-board, and have traveled more than 12,000 miles.

DISCUSSION

W. H. CONANT.—The storage battery is to the shifting device what the engine is to the car; it drives it, operates it, and must be considered, if not first, in a very important way. Since there has been no paper read upon this, I would like to emphasize the importance of selecting batteries that are large enough. To some extent batteries are consumed; they do not have a life corresponding to that of mechanical parts. If they are large enough at the outset, the life is so much greater that there is no comparison between it and the limited life that can be obtained if they are too small. Every season new devices are being brought out for use on cars, to be operated either wholly or in part by storage battery, with no provision for increased battery size; and I fear that insufficient thought is being given to the motive power that must handle this load. Electrical devices undoubtedly will increase. Perhaps we will use electric transmissions. Incidental to such important changes are the smaller devices that are being sold for use on cars. Almost every month we hear of some new device. We cannot afford to overlook the importance of having sufficient battery.

The use of electricity opens up a new field on gas cars. There are many things possible now that were not possible before. The device described tonight simplifies and even removes some of the problems that have confronted us. We will find, as we advance in knowledge of

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and experience with electricity on cars, that still further fields will be open.

I think that every contrivance that is to be operated by the battery is claimed to be very economical. The tests cited tonight cannot be questioned; they are absolutely correct under normal conditions. But the word "normal" is frequently used in place of "ideal." In fact, one of the papers touched upon the point that tests had been made to determine whether damage would be done to the gears by letting them grind. Every time the gears fail to mesh immediately because of abuse a draft of current more or less severe while it lasts is going on. Every time it takes longer than usual to start the car, the motor is drawing extra current. Every time anything goes wrong in the electrical connections, current is being taken out.

This device is undoubtedly a great step forward. I think we are going to come to some such thing, but I believe we have not yet reached the point where we can absolutely avoid any chance of short-circuit and that means a very considerable loss of current. Hitherto solenoids have always been used on an unlimited supply of current. They have been connected to lighting or power mains. If anything goes wrong in the switch or in the connection, so that the coil is left permanently on the line, the coil heats up and burns out or the fuse burns out.

The storage battery has a function that has not yet appealed to engineers, in that it is an emergency device. It presents a factor of safety. The large electric light companies and the street railway companies spend enormous sums of money for batteries simply as stand-bys. In this city there are many batteries, running into six figures of cost, that are not used more than once a year, but that once a year is the time when the batteries pay for themselves. Here is a new thought for consideration. The storage battery is an infallible source of power for any use to which you may put it. Therefore, if large enough batteries are used, you are prepared for the emergencies that must constantly arise.

My other thought is that batteries should be made more accessible or that those of you who do make them accessible should continue to have the courage of your convictions. We must not look with too much contempt upon the electric car or its early days, for many things that still ring true were learned. The tendency today is to take the batteries off the running-board because they look bad or to keep them out of sight because they do not help the general lines of the car. Years ago in the electrical vehicle field they faced the same objection, but found that the battery is too important to be hidden under a bushel. It must be made thoroughly accessible. You will bear me out, I think, in that point. Engines used to be put under the floor or seat or in some place where they would not be conspicuous; yet you found it necessary to put them out where they could be immediately accessible. As you go along with batteries you will find it good practice and advisable, I believe, to put them in a prominent place. This is not because the battery needs constant attention; it is not because it needs frequent adjustment. But

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so long as it is easier to give it proper attention, it is more certain of getting reasonable attention; the storage battery, like any other thing made by man, cannot be made infallible. It must have periodical attention just the same as anything else produced or manufactured. Just *where* the battery should be placed is something quite beyond the scope of this discussion. but I am confident you will evolve a position for it that will insure better attention, keeping the battery from injury and serious depreciation in operation.

W. A. McCarrell.—I would like to speak of a test that was made several months ago upon a Haynes car. Mr. R. J. Nightengale came down to Kokomo with the express intention of wrecking the battery on that car if he could. He thought that the gear-shift would put it out of business. Mr. Nightengale, Mr. Lease and I started with the car and traveled probably 500 miles, burning the lights night and day, shifting under all kinds of conditions. When we took hydrometer readings at the end of the test we found the battery in better condition than when we started out. Mr. Conant brought out a point as to burning out of the coils if the switch mechanism should stick. On the device as it stands, that is an absolute impossibility. There are three methods of breaking the circuit. First, if the gear goes into mesh it automatically kicks out the switch. If a man lets his clutch pedal back, if he has depressed it, there is an absolute cam movement which will break the circuit. If no button is pressed, the current is broken in the selector switch. We have yet to find one coil that did burn out. On the mechanism as it stands there, you must absolutely short-circuit two wires at once in order to draw current from the battery. We do not ground back to the frame in any shape at all.

F. N. Nutt.—Last year we used an 80-ampere hour 12-volt battery. This year we use a 60-ampere hour 12-volt battery. I think that answers the question.

H. L. Connell.—I take it from what Mr. McCarrell said about the coils burning out that there are no fuse wires.

W. A. McCarrell.—No fuse wires at all.

H. L. Connell.—Is there an emergency gear lever?

W. A. McCarrell.—That is entirely at the manufacturer's option. In this particular device there is one, but simply as a selling feature. The question is often asked by a customer, "Well, suppose something should go wrong?" You try to tell him it will not. Suppose it should. We tell him to unscrew the cap, drop a little short handle in and shift by hand. We provide lugs for that purpose.

A Member.—I would like to ask about the amount of pull necessary to start the gear-shift. In the car I have been driving recently I had trouble with the second gear sliding out. In order to determine whether the stops were in good condition I put a spring on the shifting-rod

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on which the forks are mounted, and found it took 90 pounds to pull the stop out of position, in spite of that fact it did not hold the gears in mesh. If the stops have been weakened so that 40-pound magnets will start them, it seems to me the danger of sliding out of position would be greater; and that the automobile manufacturers in making springs so that they actually take 90 pounds to start them, did so with a purpose.

W. A. McCARRELL.—The lock that holds the gears in neutral position is weak. It simply has to hold the weight of the gear so that we can provide for a weak load. The meshed-position lock is, however, very stiff, as stiff as you can make it for hand-shifting. The 40-pounds pull is only against the neutral interlock spring. Our neutralizing cam will carry the gear only as far as the neutral position. You cannot push it beyond neutral position.

A MEMBER.—Suppose you are running along at high speed, and, wanting to stop suddenly, throw the clutch away down, losing control of the gear, which, I understand, goes to neutral every time the clutch pedal is thrown down.

W. A. McCARRELL.—If the proper button is down, no matter how often you throw the clutch clear through, the gear will shoot right back again into mesh.

A MEMBER.—I would like to know the action of the mechanism in engaging high gear in cold weather, with enough congealed oil in the clutch that the release mechanism could not be tripped out. Mr. McCarrell stated that it has to come within one-eighth of an inch of the full throw before the switch disconnects the solenoid.

W. A. McCARRELL.—In case the gear did not mesh far enough to automatically break the circuit when the clutch is let back in, the return of the clutch pedal would automatically work the small cam which trips the dog that engages the master switch.

A MEMBER.—In most cars there is a short shift to high-gear position. If that shift is not completed very likely the gear will jump out.

W. A. McCARRELL.—That will depend entirely on whether it went into position, the same as in hand-shifting. The condition is exactly the same as with a hand lever.

A MEMBER.—If the gear did jump out, how would you get it in again?

W. A. McCARRELL.—By throwing the clutch pedal down again.

A MEMBER.—Pushing it down until the gear stays in?

W. A. McCARRELL.—Yes.

CHAIRMAN E. T. BIRDSALL.—How does the mechanism act if you have a multiple-disc clutch and the oil is too thick? It is well known that

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in cold weather this type of clutch has a tendency to drag so that it is very difficult to come down, say, from third to second.

W. A. McCARRELL.—The clutch dragging would probably give a little clash as you go up, but coming back it would benefit matters; as you throw it down to neutral it would catch the natural acceleration of the engine.

C. T. MYERS.—It would not do that unless you were accelerating the motor, would it?

W. A. McCARRELL.—In falling back?

C. T. MYERS.—Yes.

W. A. McCARRELL.—When you come to neutral and release the weight of the car from the engine there is a natural acceleration of the engine.

C. T. MYERS.—Not necessarily, if the hand throttle is set for an idling speed.

W. A. McCARRELL.—It would give a little clash until you got the proper speed. A little touch on your accelerator would shoot you right in.

Discussion at Metropolitan Section Meeting

GASOLINE-ELECTRIC VEHICLES

CHAIRMAN ANGLADA:—I think that the best way to open the discussion will be to ask Mr. Dey to present a short paper he has prepared. We all remember that in the old days, when there was a lot of controversy relative to the make-and-break and high-tension sparks, one said the high-tension spark was the real thing and another that the make-and-break gave the hotter spark. I think that about the same condition exists now relative to the gasoline-electric transmission. A number of engineers I know who have not had any experience with it absolutely condemn it, and others who have had experience are not very warm in its praise. I hope that the men present who have had experience with other forms of transmission not so well-known as the conventional type, notably the hydraulic transmission, will state their views as to the shortcomings of the electric transmission. Let us try to bring out the good and bad features as far as possible. Give us something to think about, because undoubtedly the electric transmission and the hydraulic and perhaps other types are coming.

HARRY E. DEY:—In the course of an article appearing in *Horseless Age* describing motor starters exhibited at the shows a year ago, I made the following remarks: "Is the electric starter of the flywheel armature

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type a step in the evolution of the combination gasoline-electric machine? It would appear that if this outfit were made larger it would recharge the battery whenever the engine had surplus power, and give the power back to assist the engine whenever overloaded. The electrical equipment could be comparatively small in rating compared with that of the engine. A number of inventors worked along these lines in the early days of the automobile, but for some reason unknown to the writer did not succeed in commercializing the system. Perhaps they were too far ahead of the times, and we may yet get this system as an evolution of the motor starter." I have favored this system for the past fifteen years or more and I still believe it is the best solution of the gearbox problem of the gasoline car.

In all the experiments I have become acquainted with it has been customary to retain the sliding gear. This appears to me to negative nearly all the good features of the system. We have to all intents and purposes an electric vehicle, capable of being driven by its electrical equipment alone. We do not require a change of gearing on an electric. Why should we with this outfit which has the assistance of the gasoline engine? My idea of such an outfit would be: an engine of twenty to thirty horsepower, having a flywheel of the motor dynamo type of about five horsepower, compounded in such a manner that the windings are in differential relation when the current is going to the battery, and cumulative when the latter is discharging. This will tend to keep down excessive charging rates and at the same time provide the motor with the general characteristics of the series machine. A battery of 100 ampere-hours at 60 volts should be sufficient for all ordinary purposes.

If desired a reversing gear could be provided, but this is not absolutely necessary, for the engine can be shut off and the electric motor reversed, driving the engine backwards. Another method would be to have a double-acting clutch that would disconnect either the engine or wheels or both. With this arrangement it would not be necessary to reverse the engine, simply backing the car with the electric motor; and in case the battery charge becomes low, the rear drive can be thrown out of commission while the engine drives the dynamo to recharge.

I presume there will be some criticism of the small electric motor rating in comparison with that of the engine. It is general practice at present, however, to allow about two horsepower per ton for driving electric pleasure cars running at twenty-five miles per hour. So it would appear that five horsepower or even less should be ample when we take into consideration that it is only the excess load that the motor has to take care of.

A battery of the rating mentioned should be able to drive the car, without the assistance of the engine, twenty to twenty-five miles; consequently there should be no danger of its becoming exhausted except in extreme cases where one might travel for many miles on a steep upgrade in a mountainous country. There are few such places in the world, how-

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ever, and even in such an extreme case one could stop and recharge the battery with the running gear thrown out.

The additional weight of such a machine need not be more than from three to four hundred pounds, for it must be taken into consideration that we are replacing the flywheel, generator for light and starting, starter, battery and gearbox.

The speed control on the lighter loads would be very largely, if not entirely, through the throttle and field, but when the load was such that the battery was being drawn upon, the control would be upon the electric motor, by varying field strength and perhaps in addition by multiple-series battery control.

In addition to the ease of control of such a machine there would be the added advantage of being able to ascend hills at nearly maximum speed, and also that in case of running out of gasoline or a breakdown of the engine, one could run many miles without the assistance of the engine.

I believe that the efficiency will be fully as high as with the present mechanical transmission, due to the fact that the battery is merely floating on the line. The electrical equipment takes care of the abnormal loads only, and on down grades power will be recovered from the action of gravity, the electric motor acting as a perfect elastic brake and saving a large amount of wear on the brake-shoes. When the engine is lightly loaded and charging takes place, the efficiency of the engine is increased due to the heavier load, which should nearly make up for the loss of transformation, especially when one considers that with the sliding gear there is a loss of from five to ten per cent. on all of the indirect speeds. While with the direct motor connection taking grades without changing gears the engine runs at a much slower speed and thus saves the gasoline, besides wear and tear on the engine.

ALLING PARKHURST:—The system as we have developed it consists of a compound-wound generator directly coupled to the gas engine, generally through a flexible coupling of the best design, a controller and one or two motors of the regular automobile storage battery type. The generator is wound for about 125 volts at normal engine speed, and the electric motors are capable of taking that voltage. The whole system is made as simple as possible from operating and maintenance standpoints. For instance, we have a simple two-speed controller. The first speed with double-motor drive, throws the motors in series across the generator. The second speed throws the motors in parallel, so that they get the full generator voltage. It is possible with some of the latest designs of slow-speed long-stroke gas engines to put the controller in either the first or second notch and (when operating with a foot throttle) have the foot throttle open normally so as to let enough gas into the engine to start it and at the same time not let the generator generate enough current to move the truck. In a recent test made with the engine turning about two hundred revolutions, the generator voltage was about two,

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which was more or less consumed by the wiring of the truck itself. Then, when the engine was brought to its normal speed, the generator gradually built up to 125 volts, the truck speed increasing correspondingly. You have simply a variable voltage proposition, the power increasing according to the voltage. It is purely a straight gasoline truck with an electric transmission, you might say. There are no clutches, no sliding gears. The controller has a single reverse point, sending the current into the motors in the reverse direction, with the double-motor drive putting the current through the motors in series.

We have developed a controller for use where we have single-motor drive. Some people are using the single motor with a worm drive. In that case we get the two speeds forward by putting the fields of the motor first in series for the first speed and then in parallel with full generator voltage for the second speed. The reverse speed is the same as the first speed forward, simply putting the current in a reverse direction through the motor.

The American La France Fire Apparatus Company have developed an aerial ladder truck, with very long wheelbase, and are using at present a four-motor drive, one motor for each wheel. The speeds are obtained by combinations of these motors in series or series-parallel. The American and British Manufacturing Company have developed a truck and also a line of fire apparatus on the same principle. A company here in New York City known as the Roland Gas Electric Vehicle Corporation, have had very marked success with this construction.

H. W. SLAUSON:—Is that system similar to the Couple Gear?

ALLING PARKHURST:—The only real difference is in the method of control and the fact that the Couple Gear has a geared motor in each hub. It is a matter of drive. The generator is about the same, and of course the way it is coupled up is the same. There are a lot of special features in the generator for this work. For instance, our generator is designed with a compound winding, having substantially an interpole construction. With about three times normal load we try to keep the voltage constant. Of course the voltage will vary with the engine speed. That is the way the speed of the truck is varied.

M. R. MACHOL:—If you can change the speed of the car by simply changing the engine speed, why is it necessary to have two speeds?

ALLING PARKHURST:—There are certain conditions, the same as in storage battery truck practice, where you strike, for instance, very heavy muddy "going" or snow or something of that kind, when you are obliged to get more torque on the rear wheels to pull out.

B. M. BESKOW:—What is the efficiency?

ALLING PARKHURST:—It is pretty hard to say just what it is. In fact I have no data on that at all.

M. R. MACHOL:—Would the efficiency be very high when you get a high torque?

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ALLING PARKHURST:—Of course the efficiency would be high with a high torque. When the motors are running in series the efficiency falls off on the motors, the same as it does in a storage battery truck. You run, for instance, on the intermediate notches with the straight storage battery trucks. With one with a four-speed controller, for example (with single-motor drive), you put the fields in series with resistance for the first-speed point. Generally the second step is either shunting the series fields or cutting out the resistance. The third step may be shunting the fields, with the fields in series-parallel for the last step. When you run the motor with the fields in series (straight series connection), you are running, of course, at a much less efficient point than with the fields in the series-parallel position.

C. M. MANLY:—The efficiency would drop considerably, would it not, with the engine running at half speed?

ALLING PARKHURST:—Of course, running at lower speed you do not get the efficiency that you do at high speed. That is true of any apparatus. You do not get the efficiency out of the gas motor running at low speed.

JOHN R. CAUTLEY:—Is there any difficulty in starting?

ALLING PARKHURST:—You mean using the generator as an electric starter for the engine?

JOHN R. CAUTLEY:—Yes.

ALLING PARKHURST:—We have not developed anything along that line more than experimental so far. But it is very feasible. For instance, I have in mind a truck of three and a half tons capacity. We are using a 7½ killowatt generator with two motors. That generator is wound for 125 volts, with fields compounded. A battery that will run about 30 volts, with fifteen lead cells or about twenty-five Edison cells, will be just about sufficient to crank the gas motor.

C. M. MANLY:—That would bring it into the pleasure car field.

ALLING PARKHURST:—Yes.

M. R. MACHOL:—Suppose you wanted to start a truck like that in very heavy going; you would start the motors in series, would you not?

ALLING PARKHURST:—Yes. That would be the ideal way to get the maximum power out of it. You can put the motors in parallel and get the maximum power out of the truck to the extent of the gas motor. It is a very flexible proposition.

M. R. MACHOL:—Assume a case where you had to climb a very steep long hill, and in order to go at two miles an hour you would have to develop the maximum horsepower of the gasoline motor; would you climb that hill in series or in parallel?

ALLING PARKHURST:—In a severe case like that I think I would climb

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in series. It is really a question of the gas motor horsepower output. If you leave the motors in parallel, probably, if you struck a condition like that, such rough "going" that you dropped down to about two miles an hour, the only thing that would happen would be to "stall" the gas motor. If you put the motors in series, you get half voltage on each motor and full current, which, of course, gives you the maximum tractive effort.

A MEMBER:—What is the ratio of the torque of those two motors when they are in series and when they are in parallel?

ALLING PARKHURST:—That is quite true. When you are in the series position, you have the full amperage from the generator going through both motors, and that means torque.

A MEMBER:—That is twice what it would be in parallel?

ALLING PARKHURST:—Yes; you multiply the torque two to one.

FIFTH AVENUE BUSES

PROF. W. C. MARSHALL:—How does the Fifth Avenue Bus Company find that this electric transmission compares with the mechanical? There is a case of buses running under the same conditions exactly, some of which are running electrically.

R. McA. LLOYD:—I think we have a pretty big subject and that it is impossible to cover it all. There is not any doubt in my mind that there are special fields for the application of the electric transmission. I think that it was desired more ten years ago than it is now, because people used to be afraid of sliding gears. Now everybody is used to them and there is less demand for the electric transmission in the case of the ordinary pleasure vehicle.

There are inherent reasons why the electric transmission cannot be a success as so far applied. It is never big enough to transmit the power that you can get out of the engine. The transmission described by Mr. Parkhurst is undoubtedly about the same thing as that on the Fifth Avenue stages. In the system applied to some of these buses there is a 35-horsepower engine, a 7-kilowatt generator and two 3-horsepower electric motors. The best you can get out of the two motors is 18 horsepower when they are slowed down to a bus speed of about two miles an hour, at which time the engine develops 35 horsepower. If they put in a motor big enough and generators big enough to chase the straight mechanical transmission over the streets, the weight and cost of construction would be prohibitive. This system can be used only in places where you do not object to going slow on hills. It has been for that reason more or less cut out of calculations on commercial vehicles, excepting where it is difficult to get in a mechanical transmission. There is no particular

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advantage in electrical transmission, it seems to me. A good many men would rather run a gas car with a mechanical transmission than an electric car with an electric control. The beauty of the electric transmission is that the motors respond to the demands upon them; when you strike a steep hill they do not stop going. On the other hand, you are converting all the mechanical energy into electrical energy, with some loss, and back into mechanical, with some more loss, and are bound to get greater consumption of gasoline over a long period. I do not represent the Fifth Avenue Bus Company, but I know that their gas-electric buses consume twenty-five per cent. more gasoline in the long run than those with ordinary gearbox.

This is only one system. If you look over the field you will find there are forty or fifty, and more coming out every day, particularly abroad, where they drive direct part of the time. Something can be said in favor of the addition of a small storage battery to help on hills. This can be charged going downhill. Here there is the disadvantage of additional weight.

I do not mean to say that I have exhausted the field, but I have certainly investigated most of the systems that are known. I think all have inherent disadvantages in the way of cost construction and inefficiency, and that the only thing they offer is the possibility of a little easier control, which I do not think is necessary, and certainly is not in as great demand as it was ten years ago.

M. R. MACHOL:—The hydraulic transmission with a gasoline engine will enable you to get on the rear wheels any torque from zero up to maximum, regardless of the speed of the gasoline engine. That is, as long as the gasoline engine is running fast enough to overcome its own internal friction, and give any appreciable power at all, the hydraulic transmission will enable you to get any drawbar pull that you happen to want. In climbing a hill it is not a question of horsepower; you can get up any hill that the motor is capable of climbing if you have only two cylinders going; on five or six horsepower you can climb the steepest hill the truck is capable of climbing at any time. At the same time you still have the absolute range of horsepower. I think that is an advantage.

W. P. KENNEDY:—What Mr. Lloyd says merely expresses the opinion that the electric transmission equipment is very much more expensive than the mechanical transmission. Yet when we consider the commercial or manufacturing side, it must be recognized that when a device is put out in experimental quantities, as is the case with these Fifth Avenue gas-electric stages, the price of such equipment is bound naturally to be very much higher than if it were the product of a very large factory making a great quantity of machines.

We have heard that the operating cost is very much higher than with the mechanical transmission in the consumption of gasoline. My information may not be correct, but I am of the impression that when the Fifth Avenue Coach Company undertook to place these electric transmis-

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sion buses on Fifth Avenue they were prompted to do so on account of the existing high cost of mechanical transmission upkeep, and that when these electric transmission buses went into service their cost of upkeep was remarkably low. Therefore it would seem rational that even though the gasoline consumption were higher than with the straight mechanical transmission bus, if the cost of that increased consumption were not so high as to compare unfavorably with the cost of mechanical transmission maintenance, this ought to be given due weight.

We also have, aside from the Fifth Avenue bus application, considerable evidence of the practicability or utility of this type of device in the Coupled Gear gasoline-electric machine. Of course that is a motor truck or tractor, and it is not expected to go very fast. In the majority of cases which I have been able to investigate, the service rendered has been very satisfactory. I know of one case where a machine having a gasoline-electric transmission did work in moving heavy weights that never could have been moved with any other form except perhaps the hydraulic transmission. An engineering contractor who wanted to transport structural material and equipment from a railroad station over a nine-mile course to a point where he was constructing a hydro-electric power plant, used successfully a Couple Gear gasoline-electric tractor. He told me that he never missed a single trip in his schedule of operation, and was able with this machine on one occasion to transport something like fifteen tons with the use of a trailer, up a 13 per cent. grade.

Do we not condemn the gasoline-electric type of machine for engineering or theoretical considerations rather than practical, for instance, by laying stress, as pointed out, on the gasoline consumption or some minor consideration without reference to its economy or practicability as a whole? I would like to have Mr. Lloyd's expression on that with reference to the Fifth Avenue bus case.

R. McA. Lloyd:—I know what the gasoline-electric transmission buses cost, several hundred dollars more than those with mechanical transmission. I do not say it is impossible to reduce the cost. In the meantime, the cost of mechanical transmission has gone down enormously and the cost of the electric dynamo and motor has not gone down very much.

HAMMER BLOW ON ENGINE BEARINGS

J. L. Breese, Jr.:—Mr. Lloyd laid stress on the upkeep of the transmission. As a matter of fact the upkeep which the electric transmission saves is not the upkeep of the transmission itself, but the upkeep of the motor. To illustrate, about four years ago Mr. Anglada and I constructed a combination trailer and tractor. We used a short-wheelbase Kelly truck for the tractor and expected to do wonders with this vehicle carrying ten tons by means of a three-ton truck. And we did do wonders. When coupled up the trailer weighed five tons and we put ten tons of coal in it. We demonstrated for one of the coal companies here in the

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city. Our record for one day was 100 tons of coal. Since then this has probably been beaten, but at that time it stood as a record. The coal company we were operating for thought we had something fine. We had for about the first week we were running, but after that we found that the engine bearings began to go. We could not account for it. We put the best driver we had on the job, kept the base full of oil, got arrested once or twice for smoking, but nothing would relieve the bearing trouble. Motor after motor ran bearings out in very short time. In a month's demonstration we put in two different motors, alternating them each week. At the end of a month's demonstration the coal company were so enthusiastic that they wanted our price on five jobs. Of course we were not in a position to manufacture them, for we knew only too well there was something radically wrong with the system.

After that experience I took the trouble to look into the matter a little further. I investigated the Couple Gear and tried to find out what troubles, if any, they had. I found that they had no engine troubles to speak of. The important point to note is that our system of trailer and tractor was precisely the same as that of the Couple Gear, except that we used a mechanical transmission, while they used an electric transmission. They had no bearing trouble while we had a great deal.

During the past year I have made some further experiments along the same lines. You probably have all heard of the Yellow Pine Company, who operate trailers for the transportation of long lengths of timber. These trailers have two wheels mounted on a fifth wheel or turntable which supports a bolster on which the timber is carried. At first they merely placed two wheels in the rear to support the overhang of the long timbers and used no drawbar. On taking a curve the wheels would bind and skid, so they resorted to a turntable in the rear and a sort of flexible bolster on the tractor. This bolster has an interesting construction. It is a small sector of a thrust bearing with a radius of twelve to fourteen feet; the races being cut from hard wood and the balls used six-inch bowling balls. This bolster had a play of about three-quarters of an inch forward and back and also laterally. This gave enough swing to the load that when a turn was taken there was no binding. Curiously enough the chief part that these balls were to play did not become evident for some time after the device had been in operation. After several months' use when they looked for bearing trouble in the natural course of events, they found to their astonishment that the bearings were in fine condition. It was also noticed that the gasoline consumption had decreased since the introduction of the ball race.

I mention the experience of the Yellow Pine Company because the point I wish to make is that the function of the electric transmission in its bearing on the upkeep of the engine, is precisely the same function as that of the ball race just described. I expain this in this way: It is easy to understand that when you have a combination tractor and trailer and the trailer is carrying the total load, its mass is probably two or three times that of the tractor. Every inequality of the road surface over which

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the trailer wheels pass, either retards or accelerates this mass, and a consequent retardation or acceleration is transmitted to the source of power. If we have a mechanical transmission a direct hammer blow is transmitted to the engine bearings. If, however, we have an electric transmission we still have the rapid changes of intertia, but they are dampened before they reach the engine bearings. The Yellow Pine people obtain this same end by the use of the ball race, absorbing the inertia change effects of the trailer before they reach the tractor wheels. Experiments have shown that either way is successful. Therefore I believe that the point I have made is at least worthy of consideration as distinctly in favor of the electric transmission.

ALLING PARKHURST:—I listened with considerable interest to what Mr. Kennedy and Mr. Lloyd had to say about the Fifth Avenue Coach Company's experience. The original generator that was built some years ago, had simply a bearing on the outside end. The engine bearing supported the other end of the generator shaft. In other words, the generator itself had only one bearing. The driving motors in the buses were of the plain-bearing type. Since those days of the plain-bearing motor, as you all probably know, all electrical automobile motors as well as the generators have had annular ball bearings. This has, of course, made a big difference.

M. R. MACHOL:—I was very much interested in what Mr. Kennedy said about a fifteen-ton load on a trailer going up a 17 per cent. grade, in connection with the use of a Couple Gear truck. Mr. Buckwalter at the last national meeting of the Society stated that he had measured the tractive effort of this truck and was unable to get 10,000 pounds tractive effort. I believe there is not a truck built excepting the truck that the Pennsylvania Railroad built, that will develop a tractive effort of over 10,000 pounds. I believe that will develop a tractive effort of over 20,000 pounds.

In connection with the question of remedying the hammer blow on the bearings of the engine, our experience with the hydraulic transmission has been that we do not have that trouble in the bearings, doing the same work. We have hauled some rather heavy trailer loads long distances with it. It is also a question whether some of the hammer blow is not due to the starting and changing speeds. If we have a semi-trailer with a load of ten or twelve tons on it, and have to start on a hill, with the ordinary type of transmission, there must be a considerable blow on the bearings, I imagine, when the clutch is dropped in and the load is jerked into motion.

ENTZ SYSTEM

DAVID BEECROFT:—We have heard from two truck concerns who have difficulty with mechanical transmissions operating in the South. Some of these trucks are operating on plantations in Louisiana; others have

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been in construction work on the Mississippi. The difficulty they have had is that when they get into first speed, it is impossible in many cases to give the truck enough momentum to carry it forward when changing, so that it is equivalent to starting on second speed. There is not sufficient flexibility and quickness in the mechanical shifting. They are looking to the electrical transmission to overcome that difficulty.

I have had a little practical experience driving a car with electrical transmission. I refer to a car equipped with the Entz system, with which you are familiar. It is a motor-generator combination without a battery, the only battery carried being one normal starting battery. I tried that car on various hills and in other places, and could not note any difference in its performance as to ability to climb hills and start on the middle of hills and accelerate, from I have noticed on other cars with the same motor fitted with mechanical gearset.

So far as the gasoline consumption of the car is concerned, I can only take it from those who have driven it several hundred miles through the State of Michigan and part of Ohio, that they have been able to get the same number of miles per gallon of fuel with the electric system as with the mechanical system in the same sort of car and using the same motor.

C. M. MANLY:—I would like to ask if Mr. Beecroft can give us any data on the torque at low speeds as compared with that at high speeds. In the drawings of the machine at the time of the last automobile show a gearbox was shown. I do not know why the gearbox was put in unless to multiply the torque at the lower speeds.

DAVID BEECROFT:—As far as I know, the gearbox is used for reversing only. When you are driving, running the gasoline motor at approximately 1,000 r. p. m., you are on direct. The system is running at about 960. In other words, when you run direct there is a loss of 40 r. p. m. in every thousand. Above the first and second speeds current from the clutch generator is consumed by the electric motor, which is really on the propeller-shaft. I do not know what the torque ratio is.

A. C. WOODBURY:—I think that in the Entz system theoretically you can get three times the torque; not practically, because of the loss in transformation. The generator member runs at a speed which is practically the difference between the engine speed and the propeller-shaft speed. If the reduction is 3 to 1 that would be two-thirds the engine speed. The windings in the motor are such that it can double the torque. You get the torque of the engine directly in the shaft acting as a clutch, and then twice that torque added by the electric motor.

A MEMBER:—Running at high speed current is not generated in the generator as such, the generator acting as an electric clutch. The fact that most of the running of gasoline machines is on the high gear, would account for the gasoline efficiency being high.

R. McA. LLOYD:—These criticisms do not apply to all systems of

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electric transmission as some of them include direct drive most of the time and the electric apparatus is merely an aid to the control. Some of these systems operate very well, but I think they are more complicated and expensive than the common mechanical transmission system. The electric transmission when considered simply as a method of control does not seem to me to possess very great advantages.

PIONEER SYSTEMS

L. G. NILSON:—My experience dates back about sixteen or seventeen years. In the pioneer days we experienced, of course, a great many troubles which are easily overcome to-day. At the same time I think we did not begin to have as many troubles as the straight gasoline people of the same period. There is something about the gas-electric system which makes it very flexible and easily controlled. And although the efficiency, counting the combined efficiency of the generator and the motor, is comparatively low, it is to a certain extent compensated for by the better performance of the engine. We all know the weakness of the gas engine; unless it is allowed to run at a reasonably high speed we get poor efficiency. With the gas-electric transmission it is perfectly feasible to run the engine at practically any speed you like. My opinion is that the success of the gas-electric transmission as applied to vehicles depends largely upon the proper proportion or proper selection of the different parts that constitute the system; whether you use the storage battery or not, it is quite important that the engine, generator and motor or motors should be not only proportioned to each other, but that the proportions be right for the work to be done.

One mistake often made in electric drives is trying to run the vehicle too fast. What I mean is this: an electric motor runs most economically at a certain speed, and should not be treated like a mechanical apparatus having an unlimited amount of power back of it. Some people think that in order to get more speed the vehicle should be geared higher, but in case of the electric it very often works the other way. By putting in a greater reduction and allowing the motor to run faster, we (under certain conditions) get a greater speed out of the car on account of the higher motor efficiency.

CLASSIFICATION NECESSARY

So many different schemes have been proposed and tried that I think we should have some sort of a grouping or classification of the different systems in order to study them intelligently. They all have some virtues and all some faults. But I believe that we will hear more about the electric transmission in the future. It is possible that if we classify and properly study each system, any designer can pick out certain features for new combinations and get good results.

As for the battery, the great trouble in the early days especially used to be that the owner did not realize the importance of proper care; the

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driver would not take enough interest in the car to learn to handle it properly. For instance, if an ignition wire fell off or the gasoline gave out, or for any other reason the engine failed, instead of thinking over what to do or trying to fix matters up, he would just go ahead and pull on the battery until it was dead, and then finally call for help. In the meantime the battery would probably have recuperated enough that when the right man came the engine could be started.

One thing I will say: that of all the Fisher cars built there was never one hauled home; they always came home under their own power, although sometimes on one motor.

CHAIRMAN ANGLADA:—Will you describe the Fisher system?

L. G. NILSON:—The Fisher system consisted of a gasoline engine to which was rigidly connected a shunt-wound generator. The main leads ran to a controller of the series-parallel type. Two motors were always used, one geared up for each rear wheel. A storage battery was placed across (floating on) the line. There were, of course, proper switches and instruments for starting the engine by converting the generator into a motor temporarily. We also had automatic control to keep the batteries from overcharging. That is a short description without going into the technical details.

From my experience I do not hesitate to say that the gasoline-electric transmission has its proper place in heavy units. I believe there is very little excuse for it in units of less than three-ton capacity, except possibly with some of the systems which are more or less mechanical, like the Entz or that of Pieper, of Liege, Belgium, which was really first brought out in this country by Charles Munson, of Indiana, in about 1898.

HEXTER TRUCK

P. K. HEXTER:—I will give you from my experience what I have found out about the gasoline-electric and my ideas upon the particular points some of the gentlemen here have taken exception to. One of the greatest difficulties I found in the mechanically-driven car was the cost of upkeep, due to the inexperience of the man we had to drive it. This was in the taxicab business. I started to look for something that would eliminate the human element more or less. I investigated the Fifth Avenue gasoline-electric buses. I found the company had fifteen buses, seven years old, running. They are still running every day in the week. The trouble they had was due entirely to the way the buses were driven, not to electrical troubles. The same identical electric equipment is in there today that was in the buses when they were first put out. The trouble was due to the gas engines, springs and steering gears employed, some of which have been replaced entirely by new units.

Gas-electrics have been in use for five years as five-ton trucks for the United States Express Company in Chicago. They have been most successful.

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Relative to the upkeep of the gas-electric, as far as gasoline consumption goes I will concede that if you take a straight mechanically-driven car and a gas-electric car and put them on a level road, where the former can run on direct drive and conditions are ideal, you will find an economy of gas consumption in favor of the mechanical drive. But this does not hold good in practice. In tests we have made using the same identical motor that the mechanically-driven has used, we have shown a better gas consumption than the mechanical drive has shown. The main saving, however, with the gas-electric is in the upkeep of the transmission. Taking the ordinary mechanically-driven car and figuring out the item grease alone, I know that in the case of a car I used to sell and handle instructions were given to the customers to fill the transmission case every month with grease. It used to take thirty pounds of grease to fill it. When you follow that up with the other items of expense and compare them with the case of the electric transmission that does not have to be filled more than once a year, there is a saving more than offsetting any disadvantages in gasoline consumption.

Design of the gas-electric and certain things installed have brought down the gasoline consumption considerably. We made a thirteen-day run in this city, eighty-four miles a day, with an average load of four tons, the truck making eight scheduled stops to the mile. During the time we had some of the severest weather. We never had to stop for any mechanical or electrical trouble. I have some figures here which are authentic:

City	Type of bus	Cost per bus per mile for operation and maintenance
New York	Gasoline	41.298
Paris	Gasoline	21.66
London	Gasoline	17.
London	Steam	16.6
London	Gas-electric	14.264

The London General Omnibus Company are operating a number of Tillings-Stevens gas-electric buses; I believe the number is about 260. The Tillings-Stevens people guarantee a tire mileage on their buses of 14,000. It is impossible to start the bus off with a jerk.

The main feature in favor of the gas electric from a practical standpoint in ease of operation. The truck can be handled and moved at the rate of one-sixteenth of a mile an hour, without any jerk whatever. A speed of ten miles per hour can be obtained within ten seconds. We have another factor of safety, that of hill climbing, or rather going downhill. With an ordinary truck going downhill it is necessary to apply the brakes; on a steep hill, such as that at Englewood or Fort George, it is necessary to apply both the service and emergency brakes. In this type of construction we can take the truck down a hill without any brake on at all. In fact a

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man can get off the truck and practically lead the car down the hill, by just putting a hand on the steering gear and guiding it.

R. McA. Lloyd:—We refer to the fact that the Fifth Avenue buses were badly designed, that that was the cause of the bad results. The Fifth Avenue stage company knew all about that; in seven years they have had time to find out what the matter was. If, in spite of the bad chassis design, they had satisfied themselves that the gasoline-electric transmission is all right, they probably would be going further with it. They had one that was not a bad design, a DeDion bus in which they substituted a single electric motor for the transmission and added a generator to the engine; that bus was a fair illustration of what could be done. I think the whole trouble was that the bus did not have the animation the mechanically-driven buses had. Neither the men who drove the buses nor the people who rode in them liked them. I think they will never get any more of that type than they have at the present time.

GOVERNORS

A. J. Slade:—Now that we have heard all the good things that Mr. Hexter has told us about his gasoline-electric transmission, may I suggest one or two improvements that some of the gas-electric people might make? First of all, we realize that the commercial vehicle has to be simplified in every way possible. On some trucks that are built we have eliminated the commutator; that is one thing. On other trucks we have eliminated the spark advance and retard; that is another thing. We still have the governors; any truck motor that has to stand up in service year in and year out must have a speed governor to restrain it from racing. Now this General Electric system of gas-electric transmission, so far as I know, has no provision to prevent the motor being raced. Possibly there might be some way of working that out in an electrical fashion in connection with the generator, so as to prevent the gas engine running at an excessively high rate of speed, or at any rate to prevent running economically at a high rate of speed; in other words, making it disadvantageous for the driver to race the engine. This is a very important point, not only when the engine is pulling but also when going downhill or coasting or running light, and is an improvement that I think ought to be incorporated. Whether it can be remains for electric transmission designers to determine.

P. K. Hexter:—We are driving our engine without a governor. The speed of the engine is 1,100; it will not go beyond that.

Alling Parkhurst:—It is purely a case of running the engine up to a certain point at which it will stall. The electrical apparatus is designed for normal running torque and speed at the normal speed of the gas motor. If you try to race the engine with the gasoline-electric the torque will go up so much and either stall the gas motor or draw it down automatically. Racing, it strikes me, happens more with an engine having a clutch con-

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nected with it. I think you cannot race an engine with the gasoline-electric system, unless you put the controller in neutral.

CHAIRMAN ANGLADA:—Can you do it on a down-grade?

ALLING PARKHURST:—Yes. If you race it, you would, of course, go at a terrific rate of speed at the same time.

H. E. DEY:—In the Fisher system that is easily overcome by holding the generator down from going beyond a certain speed, I think.

BATTERY OVERCHARGING

CHAIRMAN ANGLADA:—Would you not be apt to overcharge the battery or charge it at too high a rate?

H. E. DEY:—No, because the engine would not have the torque to produce more than so many amperes. As soon as you get up to a certain number of amperes, the generator would keep the engine from going any higher.

L. G. NILSON:—In reference to what Mr. Dey says, I know it is absolutely necessary to have some means of keeping the battery from overcharging; one cannot afford to put in a battery large enough to take the full output of the generator, but that does not complicate matters much; the matter can be covered by some sort of differential winding, or mechanically. Also a regulator can be made, working on the Watt principle, governed by battery voltage and the amperes taken by the motors. I think we will probably see more of this in the future. The present tendency of using electric starters invites the inventor back to the electric transmission.

C. M. MANLY:—Is the Hexter system the same as the General Electric system?

P. K. HEXTER:—The system is the same one that Mr. Parkhurst describes.

C. M. MANLY:—There is no battery on the line?

P. K. HEXTER:—No.

EFFICIENCY

C. M. MANLY:—With the modern gas engine we get a pretty flat torque curve, say from 800 to 1,200 revolutions. As I understand it, with this electric transmission, so long as no variation in speed is made through electric control, the torque is going to drop as the speed of the car drops, because the speed of the car is lowered by dropping the speed of the engine. That is, they drop the voltage of the generator and therefore do not get as many amperes through the electric motor, and consequently are not getting as high torque at low speeds, say at 800, as at 1,200; whereas with direct mechanical connection between the engine and the rear wheels they would be getting the same torque, practically, at 800 as at 1,200; and the horsepower would go up correspondingly with the speed due to the fact that the torque remains constant as the speed goes up. It seems to me that with the electric transmission, unless they get something

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corresponding to the mechanical connection to transmit that uniform torque they are losing one of the valuable features which has been incorporated in the later improved gas engines, that is, the flat torque curves.

CHAIRMAN ANGLADA:—What have you to say in reply to that, Mr. Parkhurst?

ALLING PARKHURST:—Our automobile motors are designed with an extremely flat torque curve. Taking the normal load, and then about two and a half times the normal load on the motor, the torque increase is about four and a half to one. In Mr. Hexter's truck the gas motor has a normal speed of about 900. If you start the engine it turns over somewhere between 150 and 200. The voltage is very low—about two volts show across the terminals of the generator. As you bring it up to a speed of 900 you get absolutely a continuous torque. The voltage increases and the amperage decreases.

C. M. MANLY:—Suppose you get 2,000 inch-pounds at 800 revolutions on the torque curve; and also 2,000 inch pounds at 1,200. Now obviously unless you change the electric connection in some way, you are either not going to use all of those 2,000 inch-pounds at 800 or it is going to take more than 2,000 inch-pounds to drive that generator at 1,200, because the voltage is going up, the electric motors are therefore going to receive more current, and it is going to take more power to produce the higher voltage and larger current at the electric motors.

CHAIRMAN ANGLADA:—Would not the speed of the electric motor increase practically in phase with the gasoline motor?

ALLING PARKHURST:—Yes, just about in accordance with the speed of the gasoline motor.

C. M. MANLY:—I am assuming no electric control. They say they do not change the electric control; they vary the car speed just by varying the speed of the engine. I can see how you do it just as soon as you change the fields. I am asking how it is done as long as the fields are left alone.

We have an engine that is producing 2,000 inch-pounds torque at 800 r.p.m., and it is not going to produce over 2,000 at 1,200. It will produce more horse-power, but not more torque. What I want to know is how to get the engine up to 1,200 r.p.m., since it can give no greater torque to furnish the greater amperage which the motors would take at the higher voltage which the higher speed of the engine would cause the generator to give. Or assuming that you can get up to 1,200 r.p.m., then it seems perfectly obvious that we were not able to use all the torque at 800 r.p.m. It seems to me that unless they vary their generator field, the system of driving does not enable them to always develop the full engine horsepower at whatever car speed it may be required. It seems to me it is a great loss of the possibilities of the electric system to attempt to use it without utilizing the valuable features of the variable field strength of the generator. I can see great possibilities in the gas-electric and think it has some very valuable features.

ALLING PARKHURST:—The gas engine we are talking about is an engine

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of about 4½-inch bore and 4½-inch stroke, with a normal speed of 900 r.p.m. The maximum torque is at a speed of about 600 r.p.m. Of course, as you increase the speed you increase the voltage, as you increase the voltage you increase the amperes, up to the engine output, and if you increase the amperes you get greater ampere turns. You therefore increase the torque.

CHAIRMAN ANGLADA:—Is the voltage of the generator proportional to its speed?

ALLING PARKHURST:—The motor is compounded. If the speed increases one hundred per cent., the voltage increases about one hundred per cent. The generator is laid out to maintain as nearly as possible a constant voltage for constant speeds. In other words, the voltage curve is very flat.

C. M. MANLY:—What happens to the engine at variable speeds? Does the voltage go up?

ALLING PARKHURST:—Yes, but not in exactly the same proportion.

C. M. MANLY:—Does it go up as fast as the speed goes up or a quarter as fast?

ALLING PARKHURST:—No, very close to constant, but it varies a little.

C. M. MANLY:—The thing we usually desire in a car is to increase torque as we lose speed on the car. I understand that when the series motor slows down its torque goes up if there is a current supply amply large on which it can draw; that is thoroughly clear. The point I am trying to make is that this generator, with uncontrolled field strength, when it is driven by the engine at 600 r.p.m., generates a certain voltage. Now when it is driven at 900 I assume that it generates a higher voltage. If I am wrong in that, I am wrong in the whole thing. If the voltage does not go up with the speed, everything is clear. It was a new idea to me when I heard it said to-night that they are driving with practically no variation of any electric control between a wide range of car speeds, and it immediately brought the idea to my mind that they must be operating very inefficiently at the lower engine speeds, because naturally if I had an engine running slowly and I wanted to get the full power out of it, I would increase the field strength of the generator so as to build up the amperes; whereas, if I were going to run at a higher speed I would decrease the field strength, because I would not need that much field strength in order to use the full capacity of the engine in driving the electric generator. When you have to lose speed in a car you usually want to increase the torque, unless you are going on easier roads; and the question was as to the way to get that increased amperage out of the generator, so as to furnish increased torque in the motor. It has to be got out of the generator.

CHAIRMAN ANGLADA:—I think the way to answer these questions is to have some one familiar with the designs, prepare a paper and give us the actual characteristics of the generator and motors.

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MEMBERS ELECTED MAY 29, 1914

MEMBERS

Austin, J. Ray, 710 Clinton St., South Bend, Ind.
Ball, Charles O., Roland Gas-Electric Vehicle Corp., Ave. B and 20th St., New York City.
Bevin, Sydney, 11 Ash St., Flushing, N. Y.
Broege, R. J., The Buda Co., Harvey, Ill.
Brown, Ralph H., American Voiturette Co., Detroit, Mich.
Coble, E. W., Auburn Automobile Co., Auburn, Ind.
Edge, Howard H., Locomobile Co. of America, Bridgeport, Conn.
Ewing, Edgar A., 2259 Oakdale Ave., Chicago, Ill.
Jacobson, Charles H., 1701 N. Main St., Los Angeles, Cal.
Karminski, Maxim, Progress Steel Co., 150 Nassau St., New York City.
Pierce, H. Shipper, Link Belt Co., Nicetown, Philadelphia, Pa.
Place, F. E., The Buda Co., Harvey, Ill.
Ross, Edward Jackson, Jr., Edison Storage Battery Co., Orange, N. J.
Shannon, John T., 2946 Brighton Ave., Los Angeles, Cal.
Wesley, George W., General Vehicle Co., Long Island City, N. Y.

ASSOCIATES

Almquist, Amandus W., 30 Edisonia Terrace, West Orange, N. J.
Beuret, Emil Jules, 345 Paulison Ave., Passaic, N. J.
Caswell, Fordyce B., 603 West 138th St., New York City.
Cornell, Fred A., 391 West First St., Dayton, O.
Dampman, Frank M., 71 Murray St., New York City.
Donahue, James F., 1840 Continental & Commercial Bank Bldg., Chicago.
Duncan, William W., Hood Rubber Co., Watertown, Mass.
Falvey, Mark B., 1430 Michigan Ave., Chicago, Ill.
Gannon, Laurence J., Raleigh Motor Car & Machine Co., Raleigh, N. C.
Hoffstaedter, Hugo, 246 West 59th St., New York City.
Jacobs, Volney J., 621 Fort St., West, Detroit, Mich.
Jones, Lloyd P., 429 Ford Bldg., Detroit, Mich.
Levett, Walker M., 464 Tenth Ave., New York City.
Marke, Paul M., 1191 Bedford Ave., Brooklyn, N. Y.
Naughton, John C., 164 East 79th St., New York City.
Rosenfeld, Maurice S., 1829 Holland Ave., New York City.
Rosenfield, Julius, 874 Manida St., New York City.
Stephens, Roderick, 220 East 138th St., New York City.
Whalen, C. P., 610 West 141st St., New York City.
Willis, Frank B., Lozier Motor Co., Detroit, Mich.

JUNIORS

Careins, William G., Haynes Automobile Co., Kokomo, Ind.
Frehse, Albert W., Thomas B. Jeffery Co., Kenosha, Wis.
Hoopes, Penrose R., 415 Wayne Ave., Wayne, Pa.
Wagner, Robert R., 825 14th Ave., Detroit, Mich.

AFFILIATE MEMBER

Greenfield Tap & Die Corp., Greenfield, Mass. Representative, Frank O. Wells, President.

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CORRECTED ADDRESSES OF MEMBERS

Arbogast, E. W., formerly branch manager, Commercial Car Division, Studebaker Corp., Chicago, Ill., now branch manager Cole Motor Co., Oshkosh, Wisconsin.

Arnold, E. E., formerly with McCue Co., Buffalo, N. Y., now with Standard Screw Products Co., Detroit, Mich.

Bowtell, Roy F., formerly metallurgical engineer, Heppenstall Forge & Knife Co., Pittsburgh, Pa., now connected with their Bridgeport, Conn., plant.

Dow, Clarence W., formerly assistant engineer, Gray & Davis, Boston, Mass., now with Detroit Electric Appliance Co., Detroit, Mich.

Fried, Ernest R., formerly with General Motors Co., Detroit, Mich., now engineer, Ferro Machine & Foundry Co., Cleveland, Ohio.

Goodspeed, L. F., formerly chief engineer and factory manager for A. C. Barley, Streator, Ill., now chief engineer Moon Motor Car Co., St. Louis, Mo.

Greenleaf, Kenneth, formerly general sales manager, Parker Transmission Co., Fulton, N. Y., now with Gray & Davis, Indianapolis, Ind.

Hill, John Wm., formerly Western sales engineer, Bantam Anti-Friction Co., Bantam, Conn., now with Hyatt Roller Bearing Co., Chicago, Ill.

Johnson, Royal K., formerly with Bowling Green Motor Co., Bowling Green, O., now with Perfection Spring Co., Cleveland, O.

Longwell, Henry E., formerly consulting engineer, Westinghouse Machine Co., Pittsburgh, Pa., now general manager, Westinghouse Air Spring Co., New Haven, Conn.

Loomis, Gilbert J., formerly president, Dayton Equipment Co., Dayton, O., now with Indestructible Tire Corp., 253 Broadway, New York City.

Muskovics, Geo. L., service man for M. P. Gould Co., 120 West 32nd St., New York City.

Newsom, H. H., formerly with McCord & Co., Detroit, Mich., now vice-president and general manager, American Voiturette Co., Detroit, Mich.

Phillips, F. F., formerly with United States Rubber Co., New York City, now with Gibney Tire & Rubber Co., New York City.

Reid, William A., is now division superintendent, Thos. B. Jeffery Co., Kenosha, Wis.

Roberts, Montague H., is now consulting engineer for Mead Johnson Co., Jersey City, N. J.

Turk, T. J., is now with Interstate Automobile Co., Muncie, Ind.

Walton, Frank, formerly service engineer, Dayton Engineering Laboratories Co., Dayton, O., now with Don Lee Co., Los Angeles, Cal.

Yuster, M. L., formerly general manager, Hess Spring & Axle Co., Carthage, O., now secretary and general manager, Yuster Axle Co., Cleveland, O.

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POSITIONS AVAILABLE

The following announcements are published for the information of members of the Society. No charge whatever is made for these announcements. Members who wish additional information will please address the office of the Society:

55. Tool draftsmen. Men experienced on motor design.

123. Production manager or production superintendent. Man who can reduce costs and get out quantities.

127. Salesman for heavy trucks on a commission basis. Not necessary to give entire time.

128 Wanted to correspond with a steel foundry molding expert, who is an authority on the positive proper layout of patterns in flasks, the placement of heads, gates and risers to insure the maximum percentage of good castings. Object, temporary engagement only in localizing difficulties and causes of castings failure.

130. Manager for foundry making automobile engine castings, aluminum brass and iron departments. Must be experienced in this line. Full information as to past experience and references should be furnished with first letter. Location middle west.

133. Young man, bright and one who has had some training; also practical experience in motor assembling.

135. Sales manager, salary and commission to be agreed upon.

136. New metal-making and electrical machinery designer. To improve good machines and tools now in use. Broad and practical knowledge of electricity, electrical machinery and power plants, necessary. Must be able to investigate any mechanical proposition, and secure best efforts of men. College graduate preferred. Knowledge of construction of motor-driven vehicles desirable. Employing company one of the largest in its field. Located in one of largest cities of Middle West.

137. Magneto designer to design special type of magneto; preferably in part time or evening work.

138. Production Manager. Must be able to handle large production of small cars. Good judge of men and handling of them. Give full particulars, references, and state experience fully or no attention given.

139. A high-grade man to sell metal working machine tools in the middle west; preferably a man with a technical education and good shop training with modern equipment. State experience and give references.

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140. Assistant to general superintendent. A man thoroughly up on modern production methods.

141. Good detail draftsman for truck work. Must be quick and accurate. Give details of training and experience. Salary $20 per week.

142. Young man familiar with machine design. Experience on presses and shears preferred. Salary dependent on experience.

143. Assistant electrical engineer wanted by an established manufacturer of ignition apparatus. Not necessary to be an ignition expert, but a technology graduate who has taken an electrical course, preferred. Work to be mostly research and invention. State salary and give experience.

145. Factory manager or general superintendent for a large machine specialty manufacturing company. Must be a master mechanic, mechanical engineer, with wide experience in manufacturing a large variety of small machine parts. State age and salary expected.

146. General Manager. A young experienced manufacturer for an established Massachusetts corporation making pressed steel parts and employing about 200 men.

147. Sales manager, experienced on commercial work and in position to invest $2,000. Exceptional opportunity.

148. First-class foundry superintendent, familiar with producing automobile castings in gray iron, aluminum and brass, in quantities, with the least possible foundry loss. None but experienced men need apply.

151. Salesman to handle special steels in New England. Must be technically trained and have had practical experience in machining and heat treating of steels.

155. Good man to take charge of assembling and get stuff through in a large business in cyclecars.

156. Experienced draftsman.

158. Draftsmen, with experience in designing small motors or generators for automobiles. For factory manufacturing small interchangeable parts for electrical apparatus. Only those having had at least three to four years' experience need apply. Salary $18 to $22.

159. Designer of successful special machine tools for multiple coincident operations, to design various machines for rapid production of small vehicle parts. Should have factory production experience.

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160. Large stable manufacturing company wants man, for sales executive position, whose record warrants immediate assumption of large possibilities; man widely experienced in modern organization and having accurate appreciation of advertising value, as well as broad commercial insight. Experience in the automobile industry is not essential.

161. Manager for service, parts division and garage of large corporation. Must have excellent engineering and executive ability, besides broad experience in this particular line of work.

162. Sales manager to superintend sale of automobile accessories. Must have experience in handling mechanical devices, and personal acquaintance with the trade.

163. Practical automobile engineer who has had experience in manufacturing a low-priced automobile and is familiar with costs, etc., and able to equip and manage the factory.

164. Clever young draftsman who can be depended upon to take care of finished detail work on bodies, windshields, tire irons, etc.

165. Engineer with executive and mechanical engineering ability to take complete charge of truck branch of million dollar concern. Technical graduate preferred. Liberal salary to right man. Exceptional opportunity.

166. Salesmen. Direct representatives calling upon automobile and other manufacturing trade with a mechanical specialty. Young men with technical or practical shop experience preferred.

167. Salesman, one that is capable of managing sales department, familiar with the automobile trade and of pleasing personality.

168. Salesmen for electrically-driven tire-pumps for private garage use, on a commission basis.

169. A high-grade retail salesman of moderate-priced pleasure cars for New York City proper.

170. Technical graduate with practical experience in testing laboratory. Must also have some knowledge of electricity and practical experience with motor car work. Salary $150 per month.

171. Checker; must have experience in pleasure car or commercial truck work. Give salary and experience.

172. Tool draftsman. State experience and salary desired.

173. Assistant engineer; must have some shop and at least two years' motor testing and operating experience. Moderate salary, which will be increased as circumstances and conditions might warrant.

174. Engineer or experienced man capable of designing attachment parts for shock absorber.

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MEN AVAILABLE

017. Executive engineer.

025. Consulting engineer can render intermittent service on manufacture or marketing of commercial cars.

026. Engineer of wide experience, designing and consulting.

034. Consulting automobile engineer.

035. Consulting automobile engineer; gasoline or electric work.

081. Designing engineer, graduate of Massachusetts Institute of Technology, with considerable experimental, factory and designing experience on pleasure cars and trucks. New England preferred.

0180. Competent motor car engineer with five years' experience in both pleasure and commercial car work, is open for engagement as chief, assistant chief, designing or experimental research engineer. Has been connected with the best motor companies and is thoroughly familiar with the manufacturing and production ends of the business. Prefer Detroit or vicinity.

0183. A wellknown consulting engineer in London, England, having representation in America, is open to negotiate manufacturing rights, and to supply all the latest information about European practice.

0196. Graduate mechanical engineer. Has had experience as designer, checker and chief draftsman for past five years with two of the largest companies in this country, making pleasure and commercial vehicles. Wishes position as chief draftsman or assistant engineer.

0198. Position as factory manager or general superintendent.

0200. Designing engineer and purchasing agent. Technical education and eleven years' practical experience in designing and purchasing, pleasure cars, and trucks from 750 pounds to 3 tons. Connected with large concerns in Detroit. Have several up-to-date designs completed to offer. References gladly given.

0201. Engineer capable of managing works, developing carbureting devices for both kerosene and gasoline, and testing generally. Can handle men and get results.

0207. Young engineer with extensive experience in designing, testing and research work on motor trucks. Capable of holding a responsible position.

0209. Designing engineer and superintendent having had seven years' experience on pleasure cars and trucks.

0210. Young technical graduate with experience in experimental work and drafting desires position in West.

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0213. Engineer, experienced in truck and pleasure car design and shop practice, expert designer of special equipment for interchangeable manufacture, open for engagement as superintendent or chief engineer.

0214. Mechanical engineer at present in charge of the designing and engineering end of a well-known truck manufacturing concern desires position as designer, chief draftsman or engineer. Age thirty-four. Eleven years' experience. First-class references.

0217. Member, mechanical engineer, Massachusetts Institute of Technology, now holding position as engineer and factory manager, desires change to position where there are greater opportunities. Fourteen years' experience in automobile industry, successfully holding positions as designing engineer of pleasure cars and trucks, and various factory positions up to and including manager of factory employing eighteen hundred men. Have served present employer eleven years. Good executive, with ability to reduce cost of design and manufacture.

0218. Foreign manager—six years with last company. Well-known in automobile trade, American as well as foreign.

0219. Would like to secure agency for approved or desirable specialties, parts or material for introduction to manufacturers. My experience and acquaintance are such as to assure results.

0220. Member with a strong acquaintance and record would like position as sales manager or salesman for first-class line of parts, material or accessories for manufacturers of automobiles or allied products. Has strong personality and been notably successful with lines that require unusual ability to introduce.

0223. A well known sales engineer, who has for eight years successfully handled a prominent imported annular ball bearing, contemplates going into business for himself. Having secured the American agency for a well-known imported ball bearing, and an imported shock absorber of considerable merit, desires to arrange with some one who will furnish capital to the extent of $7,500 cash to be used in defraying the incidental expenses in promoting sales during the first twelve months. Banking connections have been arranged for financing the merchandise accounts.

0228. Shop manager, superintendent or purchasing agent. Young man of thorough business and technical training. Experienced in gasoline motor design, building construction and petroleum refinery work.

0229. Automobile designer, at present assistant chief engineer of a prominent concern desires to make a change. Twelve years' experience in automobile design and construction.

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0231. Works manager, active technical man, thirty-seven years of age, designer and producer. Fourteen years' experience making high-grade interchangeable parts, special machinery, ordnance, etc. Available March first.

0232. Designer of several successful trucks desires position as chief draftsman, assistant engineer or chief engineer with a progressive truck company. Technical graduate. Married. Salary moderate.

0234. Designing engineer connected with one of the most successful Detroit automobile concerns. Twelve years' experience; motor specialist; good executive. Wishes position as chief engineer, assistant chief engineer or designing engineer.

0235. Engineer with eight years' experience designing and developing automobiles, commercial and cycle motors, desires position as assistant engineer, chief draftsman or designer. Vicinity of New York City preferred.

0236. Draftsman wishes position. Five years' experience on gasoline motors, gasoline pleasure cars and electric pleasure and commercial vehicles.

0237. Position desired as works manager, superintendent or chief inspector. Have handled men for twelve years. Experience covers period of twenty-two years, both large and small machinery, including printing presses, typewriters, conveying machinery and ball, roller and thrust bearings. Experience in organizing and directing inspection departments. At present employed.

0238. Graduate electrical engineer. Nine years with present employer, a well-known pioneer motor truck manufacturer, holding positions as designing and production engineer, factory manager, and branch manager in charge of sales through western New York and Pennsylvania. Able executive.

0239. Sales electrical and mechanical engineer, with some years of civil engineering. Experience in both Europe and this country. Factory management generally. Strongest possible references for executive ability. Strong personality. Available March 1st. Canadian ready to take up duties in any part of world for strong organization.

0240. Position as designer or producer by a practical man. Fourteen years' experience on medium-priced pleasure cars. Location, middle west.

0242. Position wanted as special representative in the Detroit field among automobile manufacturers.

0244. Designing or efficiency engineer for pleasure or heavy truck work. Will not consider light or cyclecar work. Have made a special study for the past three years of cars and their requirements in California and western territory.

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0245. Executive engineer or superintendent with nine years' experience in the design and production of gas engines and automobiles. Technical graduate.

0246. Understanding thoroughly all branches of the automobile business, am willing to prove my ability. Nine years' manufacturing experience. Was general manager of one company for seven years.

0247. Technical graduate desires position as assistant engineer or service manager with automobile concern. At present holding responsible position in service department. Purely personal reasons for change.

0248. Assistant to president, general manager or works manager of automobile parts plant. Four and one half years as superintendent of large ordnance and automobile parts plant, employing from eight to twelve hundred hands. Three years general manager of large engineering plant, manager steam turbines and all types of condensing equipment. Open for engagement April 1st.

0249. General manager open for an executive position of responsibility in manufacturing lines, which will afford an opportunity for substantial investment later if mutually agreeable. Detroit or vicinity preferred.

0250. Young mechanical engineer, Cornell University graduate, with three years' experience, embracing experimental laboratory and testing, designing and executive positions.

0251. Engineer with exceptional experience in small high-efficiency motors, both fours and sixes. Practical manufacture as well as technical.

0252. Young man with seven years' experience in automobile business in both factory and office end, would like to secure a position with a concern marketing pleasure cars, in either experimental or inspection departments.

0253. Position desired as production engineer or mechanical engineer on manufacturing equipment. Connected seven years with most successful automobile concern in the world. Now connected with leading automobile company. Experience along lines of manufacturing cost reducing. Good executive.

0254. Position in either engineering or testing work. Considerable experience in testing work and design of testing apparatus.

0255. Service engineer, carburetion especially. Twelve years' experience in motor car troubles. Would like position as assistant manager of service department, taking the practical detail work.

0256. Well and favorably known in automobile trade. Last five years sales manager prominent parts manufacturer. American speaking French, German and some Spanish. Prefer connection with good automobile company as export manager and foreign repre-

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sentative or salesmanager of first-class accessory or parts manufacturer.

0257. Member, formerly employed in design and layout of motor trucks, technically educated, with several years' experience in both shop and engineering departments of pleasure cars, trucks and adding machines, seeks a position in department of some good firm to sell trucks, cars or parts. Have selling ability and am a good correspondent with determination and experience to succeed in any work undertaken. Salary to be based on selling ability. Will accept temporary work in engineering lines with idea of getting into selling end later.

0258. Engineer, capable, energetic, ten years' experience on pleasure, commercial car and electric starter work, desires position as mechanical engineer or chief draftsman. Would like to connect with small live company in which later a financial interest might be taken. Have specialized on efficient running of drafting room, and would consider temporary engagement for systematizing work.

0259. Motor and chassis designer and checker. Technical graduate with shop experience; specialist on design for quantity production. Have had several months' shop experience with firm building stationary engines, jobbing shop, and with a general manufacturer.

0260. Engineer and producer; ten years' automobile experience as designer, chief engineer and factory manager. Mechanical engineer graduate, thirty-two years old, able and reliable; last position, engineer and factory manager of large plant; connections severed when plant was changed from automobile manufacturing to making of one unit only. Best reference.

0261. Engineer with thirteen years' experience in design and construction of automobiles, trucks; automobile, stationary and marine two-cycle and four-cycle engines for both gasoline and kerosene. Ten years with present employers in large factory. Open for position soon. Manager or engineer in suitable situation desired. Age, 39 years.

0262. Mechanical engineer, eight years' experience in engineering work on light trucks and small cars. Exceptionally good practical experience. Good correspondent and familiar with costs. Capable of handling responsible position. Prefer connection with concern manufacturing product or with parts manufacturer. Have an interesting cyclecar design for any one favoring the new field. Have held present position as chief engineer for past three years.

0263. Designing engineer with broad experience on designing and manufacture of pleasure cars with well-known concerns. Employed at present. Best references.

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0264. Factory manager, good organizer and producer with wide experience in engineering and production of both pleasure and commercial cars.

0265. Engineer with eleven years' experience in design and construction of high-class American cars. Specialist in development of high-speed efficiency motors. Authority on carburetion.

GEOGRAPHICAL DISTRIBUTION OF S. A. E. MEMBERS

State.	Members.	Associates.	Juniors.	Affiliates.	Total
Alabama	1	..	..	..	1
Arizona	..	1	..	..	1
California	8	6	2	..	16
Colorado	1	2	1	..	4
Connecticut	41	21	3	1	66
District of Columbia	3	1	..	..	4
Georgia	1	..	..	..	1
Illinois	60	37	6	..	103
Indiana	73	39	9	..	121
Iowa	9	2	2	..	13
Kentucky	3	..	..	..	3
Maryland	..	2	..	..	2
Massachusetts	61	19	3	1	84
Michigan	261	122	22	6	411
Minnesota	..	2	..	..	2
Missouri	6	5	1	..	12
Montana	1	..	..	..	1
Nebraska	1	3	1	..	5
New Hampshire	1	..	..	..	1
New Jersey	53	19	3	1	76
New Mexico	..	1	..	..	1
New York	226	116	20	3	366
North Carolina	..	2	1	..	3
Ohio	155	51	6	6	218
Oklahoma	1	..	..	..	1
Oregon	..	2	..	..	2
Pennsylvania	101	42	9	2	154
Rhode Island	7	1	..	..	8
South Dakota	..	..	1	..	1
Tennessee	2	..	..	..	2
Texas	3	2	1	..	6
Vermont	2	..	..	..	2
Virginia	3	..	..	..	3
Washington	..	2	1	..	3
West Virginia	1	1	..	..	2
Wisconsin	33	18	7	..	58
Canada	9	8	2	..	19
Foreign	27	3	2	..	32
Total	1,154	530	103	20	1,807

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President, Henry M. Leland, Detroit, Michigan.

Vice-president, William Guy Wall, Indianapolis, Indiana.

Vice-president, K. W. Zimmerschied, Detroit, Michigan.

Treasurer, Hermann F. Cuntz, New York.

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Secretary and General Manager, Coker F. Clarkson, New York.

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William Guy Wall, Indianapolis, Ind.

K. W. Zimmerschied, Detroit, Mich.

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C. E. COX and C. T. MYERS.....*Vice-Chairmen*
HERBERT L. CONNELL.....*Secretary and Treasurer*

(Address) 109 Webb Avenue, Detroit, Mich.
Meets first Thursday each month at 8 p. m., in the Employers' Association Rooms, Stevens Building, Detroit, Mich.

INDIANA SECTION

R. H. COMBS.....*Chairman*
GEORGE A. WEIDELY.....*Vice-Chairman*
JOHN G. WOOD.....*Treasurer*
CHAS. P. GRIMES.....*Secretary*

(Address) Wheeler & Schebler, Indianapolis, Ind.
Meets first Tuesday after first Wednesday each month at 8 p. m., at the Hoosier Motor Club in the Claypool Hotel, Indianapolis, Ind.

METROPOLITAN SECTION

JOSEPH A. ANGLADA.....*Chairman*
HERBERT CHASE.....*Treasurer*
N. B. POPE.....*Secretary*

(Address) 1790 Broadway, New York City.
Meets last Thursday each month, except July and August, 8 p. m., at the Automobile Club of America, 247 West Fifty-fourth Street, New York City.

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Members are requested to advise the S. A. E. office promptly of change of address, using form herewith:

SECRETARY,

SOCIETY OF AUTOMOBILE ENGINEERS,

1790 Broadway, New York City.

Please change my address now appearing on your records, to the following:

Company connected with.....

Profession or Position.....

Address of Company.....

Address for Mail.....

Articles Manufactured.....

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Very truly yours,

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S. A. E. Member.

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SOCIETY OF AUTOMOBILE ENGINEERS,

1790 BROADWAY, NEW YORK CITY.

DEAR SIR:—

We are manufacturing the following articles in compliance with the standards and recommended practices accepted by the S. A. E.:

Article	*Carried in Stock*
.....	.....
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Very truly yours,

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COMPANY

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BY

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ADDRESS

Date.....

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1790 BROADWAY, NEW YORK CITY.

Please send application blank to

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NAME

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POSITION AND COMPANY

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S. A. E. MEMBER

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Papers for Summer Meeting

S. A. E. BULLETIN

Vol. VI June, 1914 No. 3

JUN 29 1914

STEEL SPECIFICATIONS
PNEUMATIC TIRE RIM TEST
EUROPEAN RIM STANDARDS
ELECTRIC DEVICES FOR AUTOMOBILES
THE IDEAL CAR
SIX-CYLINDER CARS
MOTOR TRUCK PERFORMANCE
FOUR-SPLINE PRACTICE
TAXATION OF MOTOR VEHICLES
ENGINE LUBRICATING OIL

Issued to Members
by the

SOCIETY OF
AUTOMOBILE ENGINEERS

1790 Broadway, New York

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S. A. E. Bulletin

VOL. VI JUNE, 1914 No. 3

Published monthly by the Society of Automobile Engineers
1790 Broadway, New York
HENRY M. LELAND, President. COKER F. CLARKSON, Secretary.
HERMANN F. CUNTZ, Treasurer.

Entered as second-class matter, April 9, 1912, at the post office at New York, New York, under the Act of July 16, 1894.

SEMI-ANNUAL MEETING

CAPE MAY, N. J., JUNE 23-26

PROGRAM

Tuesday, June 23

Standards Committee meeting—2 p. m.
Meeting of Boards of Governors of Sections—8 p. m.

Wednesday, June 24, 2 P. M.

BUSINESS SESSION

President's Address.
Treasurer's Report.
Report of Tellers of Election of Members.
Discussion of proposed Constitutional Amendment.
New Business.

PROFESSIONAL SESSION

Report of Research Division—David L. Gallup, Chairman.

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Report of Iron and Steel Division* — Henry Souther, Chairman.

Report of Miscellaneous Division—John G. Utz, Chairman.

Thursday, June 25, 9.30 A. M.

PROFESSIONAL SESSION

Report of Pleasure Car Wheels Division*—Henry Souther, Chairman.

S. M. M. T. Standard Rims*—E. R. Hall.

Possibility and Difficulties of Formulating Acceptable Recommendations for One Standard Felloe Band for Wheels to Be Equipped with Pneumatic Tires—C. C. Carlton.

A General Summary of the Truck Tire Situation†—J. E. Hale.

Starting, Lighting and Ignition Devices*—A. D. Libby.

Electric Transmission for Motor Cars—J. B. Entz.

Thursday, 2 P. M.

Ideal Car Discussion—E. T. Birdsall, Herbert Chase°, C. E. Davis‡, Karl L. Herrmann, Robt. McA. Lloyd, Jos. Tracy.

Correct Distribution of Material in Automobile Construction* —A. P. Brush.

Highest Quality Six-Cylinder Chassis for America* — A. Ludlow Clayden.

Tendency in European Car Construction‡—R. W. A. Brewer.

Power and Performance of Gasoline Motor Trucks*—C. T. Myers.

Report of Electrical Equipment Division† — A. L. Riker, Chairman.

Report of Electric Vehicle Division—A. J. Slade, Chairman.

Report of Broaches Division*—C. W. Spicer, Chairman.

*Contained in this Bulletin.
†Printed in May Bulletin.
°Remarks printed in this Bulletin.
‡Remarks printed in May Bulletin.

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Friday, June 26, 9.30 A. M.

PROFESSIONAL SESSION

Tap Drill Sizes and Causes of Stripped Threads°—H. E. Harris.

Report of Motor Testing Division—J. O. Heinze, Chairman.

Report of Ball and Roller Bearings Division—Howard Marmon, Chairman.

Engineering Basis for Taxation of Motor Vehicles‡—C. O. Egerton, S. I. Fekete.

Characteristics of an Automobile Engine Lubricant‡—Prof. David L. Gallup.

PROGRAM OF STANDARDS COMMITTEE MEETING

REPORTS

Ball and Roller Bearing Division†

Progress report on reducing number of stock sizes of roller bearings.

Broaches Division‡

Four-spline practice.

Castle nut for use with taper fittings.

Electrical Equipment Division°

Temperature test of insulation material.

Recommendation of single-wire system.

(It is possible that a sub-committee will report on designs of fittings for a complete single-wire system of electrical apparatus for gasoline automobiles.)

Electrical Vehicle Division†

Progress report on work to be undertaken and reference of same to various subcommittees.

°Printed in May Bulletin.
‡Printed in this Bulletin.
†Not printed.

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*Iron and Steel Division**

Reduction in number and modification of S. A. E. steel specifications.

Physical properties of S. A. E. steels.

Lock Washer Division°

Communication from chairman.

Motor Testing Division‡

Forms for recording performance and details of internal combustion motors and their accessories.

Cole for use in connection with the forms.

Miscellaneous Division°

Spark Plug shell.

Fit in tapped hole.

Rod and yoke end pins.

License pads.

Gasoline specification.

Lubricating oil.

Extension of S. A. E. standard threads for dimensions extending beyond 1½" diameter.

*Pleasure Car Wheels Division**

Routine test of pneumatic tire rims.

Recommended sizes for pneumatic tires.

Difficulty of modifying to common basis cross-section of various types of demountable rims.

Research Division°

Progress report on tests to determine proper tap drill sizes in various materials.

Standards Exchange Division°

Co-operation with Automobile Engine Manufacturers' Association.

Outside diameter of flange and other points in connection with unit-power plant transmission.

Truck Standards Division°

Communications received as to industrial truck wheel sizes.

New Business

ALL MEMBERS OF THE SOCIETY ARE WELCOME AT THE STANDARDS COMMITTEE MEETING.

°Not printed.
*Printed in this Bulletin.
‡Printed in separate pamphlet form.

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GOOD ADVICE

My dear Confrere:

The interest on the part of the members in the midsummer meeting at Cape May is becoming more intense as the time approaches, but a few of our fellow members have been unable to decide definitely whether they can be at the meeting. I will therefore ask you as a personal favor to speak to each member of the S. A. E. with whom you come in contact, or telephone or write to each one you know, impressing upon him the professional, trade and social benefits to be derived from attending the meeting. By doing this you will be assisting the General Committee on Arrangements as well as conferring a favor upon your friend, and you will have a knowledge that you have done your share to make the meeting the success which you want it to be. The general committee, of which the writer is a member, counts upon you lending the support which you would expect if you were a member of the committee, and if you desire any information which has not been furnished to you in the various letters which have been sent you, write to the S. A. E. headquarters and ask questions. What we want now and must have is your co-operation, because we want the Cape May meeting to be the best from the standpoint of attendance and professional and social benefit to the member that the S. A. E. has ever held. With your co-operation and enthusiasm the meeting will be all that any of us anticipate. Get the names and addresses from the list of S. A. E. members.

If it is a question of time, why not consider the trip to Cape May in the light of a vacation which you expect to take anyway? Spend a few days at Cape May and deduct it from your regular vacation. Also remember that no man is indispensable and that you will return from Cape May with additional energy to make up for any time that you spent away from your business. It is likely that you will make friends at the meeting who will be of a very direct and substantial value.

Yours respectfully,

JOSEPH A. ANGLADA,
Chairman Metropolitan Section S. A. E.

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Submitted for Discussion—Not in Effect Until Accepted by Society of Automobile Engineers

FIFTH REPORT OF THE IRON AND STEEL DIVISION

SPECIFICATION NUMBERS

We recommend that the numeral index system specified in our Third Report, accepted at the January, 1912, meeting of the Society (see S. A. E Transactions, Vol. 7, Part I, page 32), be modified to the extent of eliminating the use of the hyphen between numbers, the specification number for .10 carbon steel, for example, becoming 1010 instead of 10-10.

CARBON STEELS

We recommend that steels 1030, 1040, 1050 and 1080 be eliminated and that three new carbon steels, to be numbered 1025, 1035 and 1045 (specified hereinafter) be accepted.

We further recommend that the phosphorus and sulphur content of the carbon steels be specified as .045 per cent. and .05 per cent., respectively, except in the case of steel 1095, in the case of which we recommend that the phosphorus content remain as heretofore, namely, .04 per cent. Also that the manganese content of steel No. 1020 be specified as .30 to .60 per cent. (.45 per cent. desired), instead of .50 to .80 per cent. (.65 per cent. desired).

NICKEL STEELS

We recommend that steels 2325, 2345 and 2350 be eliminated. Also that the sulphur content of the nickel steels be specified as .045 per cent.

NICKEL CHROMIUM STEELS

We recommend that the classification of nickel chromium steels into "low," "medium" and "high," be discontinued. Also that steels 3115, 3145, 3150, 3215, 3220, 3225, 3230, 3235, 3245, 3315, 3325, 3330, 3335 and 3345 be eliminated. And that three new nickel chromium steels, to be numbered X3315, X3335 and X3350 (specified hereinafter), be accepted.

Also that the low limit of chromium in steels 3120, 3125, 3130, 3135 and 3140 be specified as .45 per cent. And that in these five last mentioned steels the sulphur content be specified as .045 per cent., the phosphorus content remaining as heretofore, namely, .04 per cent. Also that the chromium content in steels 3240 and 3250 be specified as .90 to 1.25 per cent. (1.10 per cent. preferred).

NICKEL CHROMIUM VANADIUM STEELS

We recommend that steels 4115, 4120, 4125, 4130, 4135, 4140, 4145, 4150 and 4215, 4220, 4225, 4230, 4235, 4240, 4245 and 4250 be eliminated.

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CHROMIUM STEELS

We recommend that three new chromium steels, to be numbered 5120, 5140 and 5165 (specified hereinafter), be accepted.

CHROMIUM VANADIUM STEELS

We recommend that steel 6115 be eliminated.

The effect of the acceptance by the Society of the above stated recommendations would be to make the specifications for S. A. E. steels as appears hereinbelow, all other previously recommended and accepted steels being eliminated.*

CARBON STEELS

SPECIFICATION No. 1010

Carbon	.05% to	.15%	(.10% desired)
Manganese	.30% to	.60%	(.45% desired)
Phosphorus, not to exceed		.045%	
Sulphur, not to exceed		.05%	

SPECIFICATION No. 1020

Carbon	.15% to	.25%	(.20% desired)
Manganese	.30% to	.60%	(.45% desired)
Phosphorus, not to exceed		.045%	
Sulphur, not to exceed		.05%	

SPECIFICATION No. 1025

Carbon	.20% to	.30%	(.25% desired)
Manganese	.50% to	.80%	(.65% desired)
Phosphorus, not to exceed		.045%	
Sulphur, not to exceed		.05%	

SPECIFICATION No. 1035

Carbon	.30% to	.40%	(.35% desired)
Manganese	.50% to	.80%	(.65% desired)
Phosphorus, not to exceed		.045%	
Sulphur, not to exceed		.05%	

SPECIFICATION No. 1045

Carbon	.45% to	.50%	(.45% desired)
Manganese	.50% to	.80%	(.65% desired)
Phosphorus, not to exceed		.045%	
Sulphur, not to exceed		.05%	

*The Iron and Steel Division recommends in this report the continuance and acceptance of 42 steels. Of these 42, 9 are recommended for the first time in this report, which also recommends the elimination of 41 steels previously recommended by the Iron and Steel Division and accepted by the Society. (See S. A. E. Transactions, Vol. 7, Part I, page 32, January, 1912, and Vol. 8, Part II, page 7, June, 1913.)

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SPECIFICATION No. 1095

Carbon	.90% to 1.05%	(.95% desired)
Manganese	.25% to .50%	(.35% desired)
Phosphorus, not to exceed	.04%	
Sulphur, not to exceed	.05%	

SCREW STOCK

SPECIFICATION No. 1114

Carbon	.08% to .20%	
Manganese	.30% to .80%	
Phosphorus, not to exceed	.12%	
Sulphur	.05% to .12%	

STEEL CASTINGS

SPECIFICATION No. 1235

Carbon	.30% to .40%	(.35% desired)
Manganese	.50% to .80%	(.65% desired)
Phosphorus, not to exceed	.05%	
Sulphur, not to exceed	.05%	
Silicon	.10% to .30%	

NICKEL STEELS

SPECIFICATION No. 2315

Carbon	.10% to .20%	(.15% desired)
Manganese	.50% to .80%	(.65% desired)
Phosphorus, not to exceed	.04%	
Sulphur, not to exceed	.045%	
Nickel	3.25% to 3.75%	(3.50% desired)

SPECIFICATION No. 2320

Carbon	.15% to .25%	(.20% desired)
Manganese	.50% to .80%	(.65% desired)
Phosphorus, not to exceed	.04%	
Sulphur, not to exceed	.045%	
Nickel	3.25% to 3.75%	(3.50% desired)

SPECIFICATION No. 2330

Carbon	.25% to .35%	(.30% desired)
Manganese	.50% to .80%	(.65% desired)
Phosphorus, not to exceed	.04%	
Sulphur, not to exceed	.045%	
Nickel	3.25% to 3.75%	(3.50% desired

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SPECIFICATION No. 2335

Carbon	.30% to .40%	(.35% desired)
Manganese	.50% to .80%	(.65% desired)
Phosphorus, not to exceed	.04%	
Sulphur, not to exceed	.045%	
Nickel	3.25% to 3.75%	(3.50% desired)

SPECIFICATION No. 2340

Carbon	.35% to .45%	(.40% desired)
Manganese	.50% to .80%	(.65% desired)
Phosphorus, not to exceed	.04%	
Sulphur, not to exceed	.045%	
Nickel	3.25% to 3.75%	(3.50% desired)

NICKEL CHROMIUM STEELS

SPECIFICATION No. 3120

Carbon	.15% to .25%	(.20% desired)
Manganese	.50% to .80%	(.65% desired)
Phosphorus, not to exceed	.04%	
Sulphur, not to exceed	.045%	
Nickel	1.00% to 1.50%	(1.25% desired)
Chromium*	.45% to .75%	(.60% desired)

SPECIFICATION No. 3125

Carbon	.20% to .30%	(.25% desired)
Manganese	.50% to .80%	(.65% desired)
Phosphorus, not to exceed	.04%	
Sulphur, not to exceed	.045%	
Nickel	1.00% to 1.50%	(1.25% desired)
Chromium*	.45% to .75%	(.60% desired)

SPECIFICATION No. 3130

Carbon	.25% to .35%	(.30% desired)
Manganese	.50% to .80%	(.65% desired)
Phosphorus, not to exceed	.04%	
Sulphur, not to exceed	.045%	
Nickel	1.00% to 1.50%	(1.25% desired)
Chromium*	.45% to .75%	(.60% desired)

*Another grade of this type of steel is available with chromium content of .15 per cent. to .45 per cent. The physical properties of this grade are somewhat lower than those of the grade with the chromium content indicated in specifications Nos. 3120, 3125, 3130, 3135 and 3140.

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SPECIFICATION No. 3135

Carbon	.30% to .40%	(.35%	desired)
Manganese	.50% to .80%	(.65%	desired)
Phosphorus, not to exceed	.04%		
Sulphur, not to exceed	.045%		
Nickel	1.00% to 1.50%	(1.25%	desired)
Chromium*	.45% to .75%	(.60%	desired)

SPECIFICATION No. 3140

Carbon	.35% to .45%	(.40%	desired)
Manganese	.50% to .80%	(.65%	desired)
Phosphorus, not to exceed	.04%		
Sulphur, not to exceed	.045%		
Nickel	1.00% to 1.50%	(1.25%	desired)
Chromium*	.45% to .75%	(.60%	desired)

SPECIFICATION No. 3220

Carbon	.15% to .25%	(.20%	desired)
Manganese	.30% to .60%	(.45%	desired)
Phosphorus, not to exceed	.04%		
Sulphur, not to exceed	.04%		
Nickel	1.50% to 2.00%	(1.75%	desired)
Chromium	.90% to 1.25%	(1.10%	desired)

SPECIFICATION No. 3230

Carbon	.25% to .35%	(.30%	desired)
Manganese	.30% to .60%	(.45%	desired)
Phosphorus, not to exceed	.04%		
Sulphur, not to exceed	.04%		
Nickel	1.50% to 2.00%	(1.75%	desired)
Chromium	.90% to 1.25%	(1.10%	desired)

SPECIFICATION No. 3240

Carbon	.35% to .45%	(.40%	desired)
Manganese	.30% to .60%	(.45%	desired)
Phosphorus, not to exceed	.04%		
Sulphur, not to exceed	.04%		
Nickel	1.50% to 2.00%	(1.75%	desired)
Chromium	.90% to 1.25%	(1.10%	desired)

*Another grade of this type of steel is available with chromium content of .15 per cent. to .45 per cent. The physical properties of this grade are somewhat lower than those of the grade with the chromium content indicated in specifications Nos. 3120, 3125, 3130, 3135 and 3140.

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SPECIFICATION No. 3250

Carbon	.45%	to	.55%	(.50% desired)
Manganese	.30%	to	.60%	(.45% desired)
Phosphorus, not to exceed			.04%	
Sulphur, not to exceed			.04%	
Nickel	1.50%	to	2.00%	(1.75% desired)
Chromium	.90%	to	1.25%	(1.10% desired)

SPECIFICATION No. X3315

Carbon	.10%	to	.20%	(.15% desired)
Manganese	.45%	to	.75%	(.60% desired)
Phosphorus, not to exceed			.04%	
Sulphur, not to exceed			.04%	
Nickel	2.75%	to	3.25%	(3.00% desired)
Chromium	.60%	to	.95%	(.80% desired)

SPECIFICATION No. X3335

Carbon	.30%	to	.40%	(.35% desired)
Manganese	.45%	to	.75%	(.60% desired)
Phosphorus, not to exceed			.04%	
Sulphur, not to exceed			.04%	
Nickel	2.75%	to	3.25%	(3.00% desired)
Chromium	.60%	to	.95%	(.80% desired)

SPECIFICATION No. X3350

Carbon	.45%	to	.55%	(.50% desired)
Manganese	.45%	to	.75%	(.60% desired)
Phosphorus, not to exceed			.04%	
Sulphur, not to exceed			.04%	
Nickel	2.75%	to	3.25%	(3.00% desired)
Chromium	.60%	to	.95%	(.80% desired)

SPECIFICATION No. 3320

Carbon	.15%	to	.25%	(.20% desired)
Manganese	.30%	to	.60%	(.45% desired)
Phosphorus, not to exceed			.04%	
Sulphur, not to exceed			.04%	
Nickel	3.25%	to	3.75%	(3.50% desired)
Chromium	1.25%	to	1.75%	(1.50% desired)

SPECIFICATION No. 3340

Carbon	.35%	to	.45%	(.40% desired)
Manganese	.30%	to	.60%	(.45% desired)
Phosphorus, not to exceed			.04%	
Sulphur, not to exceed			.04%	
Nickel	3.25%	to	3.75%	(3.50% desired)
Chromium	1.25%	to	1.75%	(1.50% desired)

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CHROMIUM STEELS

SPECIFICATION No. 5120

Carbon	.15% to	.25%	(.20% desired)
Manganese*			
Phosphor, not to exceed		.04%	
Sulphur, not to exced		.045%	
Chromium	.65% to	.85%	(.75% desired)

SPECIFICATION No. 5140

Carbon	.35% to	.45%	(.40% desired)
Manganese*			
Phosphor, not to exceed		.04%	
Sulphur, not to exced		.045%	
Chromium	.65% to	.85%	(.75% desired)

SPECIFICATION No. 5165

Carbon	.60% to	.70%	(.65% desired)
Manganese*			
Phosphorus, not to exceed		.04%	
Sulphur, not to exceed		.045%	
Chromium	.65% to	.85%	(.75% desired)

SPECIFICATION No. 5195

Carbon	.90% to	1.05%	(.95% desired)
Manganese	.20% to	.45%	(.35% desired)
Phosphorus, not to exceed		.03%	
Sulphur, not to exceed		.03%	
Chromium	.90% to	1.10%	(1.00% desired)

SPECIFICATION No. 51120

Carbon	1.10% to	1.30%	(1.20% desired)
Manganese	.20% to	.45%	(.35% desired)
Phosphorus, not to exceed		.03%	
Sulphur, not to exceed		.03%	
Chromium	.90% to	1.10%	(1.00% desired)

SPECIFICATION No. 5295

Carbon	.90% to	1.05%	(.95% desired)
Manganese	.20% to	.45%	(.35% desired)
Phosphorus, not to exceed		.03%	
Sulphur, not to exceed		.03%	
Chromium	1.10% to	1.30%	(1.20% desired)

*Two types of steel are available in this class, viz., one with manganese .25 to .50 per cent. (.35 per cent. desired), and silicon not over .20 per cent.; the other with manganese .60 to .80 per cent. (.70 per cent. desired), and silicon .15 to .50 per cent.

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SPECIFICATION No. 52120

Carbon	1.10% to 1.30%	(1.20% desired)
Manganese	.20% to .45%	(.35% desired)
Phosphorus, not to exceed	.03%	
Sulphur, not to exceed	.03%	
Chromium	1.10% to 1.30%	(1.20% desired)

CHROMIUM VANADIUM STEELS

SPECIFICATION No. 6120

Carbon	.15% to .25%	(20% desired)
Manganese	.50% to .80%	(.65% desired)
Phosphorus, not to exceed	.04%	
Sulphur, not to exceed	.04%	
Chromium	.70% to 1.10%	(.90% desired)
Vanadium, not less than	.12%	(.18% desired)

SPECIFICATION No. 6125

Carbon	.20% to .30%	(25% desired)
Manganese	.50% to .80%	(.65% desired)
Phosphorus, not to exceed	.04%	
Sulphur, not to exceed	.04%	
Chromium	.70% to 1.10%	(.90% desired)
Vanadium, not less than	.12%	(.18% desired)

SPECIFICATION No. 6130

Carbon	.25% to .35%	(.30% desired)
Manganese	.50% to .80%	(.65% desired)
Phosphorus, not to exceed	.04%	
Sulphur, not to exceed	.04%	
Chromium	.70% to 1.10%	(.90% desired)
Vanadium, not less than	.12%	(.18% desired)

SPECIFICATION No. 6135

Carbon	.30% to .40%	(.35% desired)
Manganese	.50% to .80%	(.65% desired)
Phosphorus, not to exceed	.04%	
Sulphur, not to exceed	.04%	
Chromium	.70% to 1.10%	(.90% desired)
Vanadium, not less than	.12%	(.18% desired)

SPECIFICATION No. 6140

Carbon	.35% to .45%	(.40% desired)
Manganese	.50% to .80%	(.65% desired)
Phosphorus, not to exceed	.04%	
Sulphur, not to exceed	.04%	
Chromium	.70% to 1.10%	(.90% desired)
Vanadium, not less than	.12%	(.18% desired)

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SPECIFICATION No. 6145

Carbon	.40% to .50%	(.45%	desired)
Manganese	.50% to .80%	(.65%	desired)
Phosphorus, not to exceed	.04%		
Sulphur, not to exceed	.04%		
Chromium	.70% to 1.10%	(.90%	desired)
Vanadium, not less than	.12%	(.18%	desired)

SPECIFICATION No. 6150

Carbon	.45% to .55%	(.50%	desired)
Manganese	.50% to .80%	(.65%	desired)
Phosphorus, not to exceed	.04%		
Sulphur, not to exceed	.04%		
Chromium	.70% to 1.10%	(.90%	desired)
Vanadium, not less than	.12%	(.18%	desired)

SPECIFICATION No. 6195

Carbon	.90% to 1.05%	(.95%	desired)
Manganese	.20% to .45%	(.35%	desired)
Phosphorus, not to exceed	.03%		
Sulphur, not to exceed	.03%		
Chromium	.90% to 1.10%	(1.00%	desired)
Vanadium, not less than	.12%	(.18%	desired)

SILICO-MANGANESE STEEL

SPECIFICATION No. 9250

Carbon	.45% to .55%	(.50%	desired)
Manganese	.60% to .80%	(.70%	desired)
Phosphorus, not to exceed	.04%		
Sulphur, not to exceed	.04%		
Silicon	1.75% to 2.00%	(1.90%	desired)

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Submitted for Discussion—Not in Effect Until Accepted by Society of Automobile Engineers

SEVENTH REPORT OF THE BROACHES DIVISION

Following the instructions of the Society at the last January meeting to investigate and report on four-spline practice, your committee would report that a general invitation was issued through the S. A. E. Bulletin for all automobile engineers interested to answer several questions which were proposed in regard to the satisfaction received from their present practice. This was followed up by special letters to the engineers of a selected list of about fifty leading automobile manufacturers. Four questions were asked, as follows:

(1) Do you use four-spline construction?

(2) Is your present design of four-spline shaft entirely satisfactory. If not, why?

(3) Have you any objection to equally dividing the periphery in four-spline construction as has already been done in the case of six- and ten-spline?

(4) If so, why and what proportion do you recommend?

No replies were received excepting from those to whom personal letters were written and only 23 replies were received in response to the 50 letters sent out. Of these, 10 were using four-spline construction and 13 were not. As to the equal division of the periphery, five objected and three were in favor. Of those who objected only two gave the same reason. Two of the reasons given referred to the manufacturing cost.

After careful consideration of the various points brought out in the replies to the questions and of the subject in general, the chief reasons for equal division of the periphery may be summarized as follows:

(1) Uniformity in general design with the six- and ten-spline proportions already accepted.

(2) In the milling operation there would be less material to be removed and surface to be covered; therefore less cost of shaft.

(3) In the grinding operation there would be less surface to be covered; therefore less expense in manufacturing the shaft.

(4) The shaft would be stiffer.

The foregoing enumerated advantages of the equal division appear to the committee to have much less weight than the reasons for unequal division which were as follows:

Unequal division provides:

(1) Larger bearing surface on the small diameter. This is especially important when auxiliary grooves are provided at the root of the spline of the shaft, which grooves are in some cases necessary in order to develop the necessary depth of straight surface on the side of the spline when the spline is developed by the hobbing process. The auxiliary

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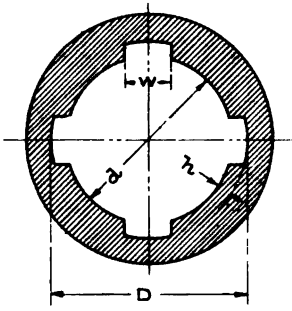
4 SPLINE FITTINGS

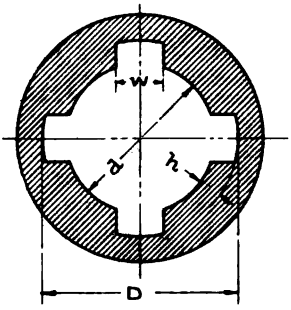
PERMANENT FIT



4-A

w =.241 D
h =.075 D
d =.850 D

TO SLIDE WHEN NOT UNDER LOAD



4-B

w =.241 D
h =.125 D
d =.750 D

NOMINAL DIA.	D	d	w	h	T	D	d	w	h	T
3/4	.750 / .749	.657 / .656	.181 / .180	.056 / .055	78	.750 / .749	.562 / .561	.181 / .180	.094 / .093	123
7/8	.875 / .874	.744 / .743	.211 / .210	.066 / .065	107	.875 / .874	.656 / .655	.211 / .210	.109 / .108	167
1	1.000 / .999	.850 / .849	.241 / .240	.075 / .074	139	1.000 / .999	.750 / .749	.241 / .240	.125 / .124	219
1 1/8	1.125 / 1.124	.956 / .955	.271 / .270	.084 / .083	175	1.125 / 1.124	.844 / .843	.271 / .270	.141 / .140	277
1 1/4	1.250 / 1.249	1.062 / 1.061	.301 / .300	.094 / .093	217	1.250 / 1.249	.937 / .936	.301 / .300	.156 / .155	341
1 3/8	1.375 / 1.374	1.169 / 1.168	.331 / .330	.103 / .102	262	1.375 / 1.374	1.031 / 1.030	.331 / .330	.172 / .171	414
1 1/2	1.500 / 1.499	1.275 / 1.274	.361 / .360	.112 / .111	311	1.500 / 1.499	1.125 / 1.124	.361 / .360	.187 / .186	491
1 5/8	1.625 / 1.624	1.381 / 1.380	.391 / .390	.122 / .121	367	1.625 / 1.624	1.219 / 1.218	.391 / .390	.203 / .202	577
1 3/4	1.750 / 1.749	1.487 / 1.486	.422 / .421	.131 / .130	424	1.750 / 1.749	1.312 / 1.311	.422 / .421	.219 / .218	670
2	2.000 / 1.998	1.700 / 1.698	.482 / .480	.150 / .148	555	2.000 / 1.998	1.500 / 1.498	.482 / .480	.250 / .248	875
2 1/4	2.250 / 2.248	1.912 / 1.910	.542 / .540	.169 / .167	703	2.250 / 2.248	1.687 / 1.685	.542 / .540	.281 / .279	1106
2 1/2	2.500 / 2.498	2.125 / 2.123	.602 / .600	.187 / .185	865	2.500 / 2.498	1.875 / 1.873	.602 / .600	.312 / .310	1365
3	3.000 / 2.998	2.550 / 2.548	.723 / .721	.225 / .223	1249	3.000 / 2.998	2.250 / 2.248	.723 / .721	.375 / .373	1969

T= 1000 X 4 X MEAN R X h X 1 = INCH-POUNDS TORQUE CAPACITY PER INCH BEARING LENGTH AT 1000 LBS. PRESSURE PER SQUARE INCH ON SIDES OF SPLINES. NO ALLOWANCE IS MADE FOR RADII ON CORNERS NOR FOR CLEARANCES.

groove is also of advantage when the small diameter of the shaft is finished by grinding, as it obviates the necessity of grinding into a sharp corner.

(2) Lighter shaft.

(3) Less material to be removed by the broach and therefore less expensive broaching operation.

(4) Other things being equal, a gear or other part containing the broached hole would probably go out of shape in heat treating somewhat

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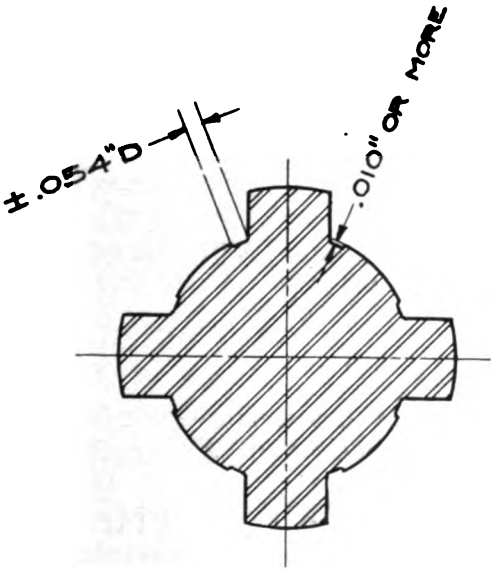

less if provided with narrow slots than it would with the comparatively wide slots resulting from an equal division of the periphery.

The committee also carefully considered nearly one hundred different designs of four-spline transmission shafts that are being used in 1914 cars in quantities of from 2,500 to 30,000 or more each. No one of these designs seemed to meet all of the required features in *every* particular. If two designs differ in *any* important particular, they are not interchangeable, and even had the committee decided to recommend one of the designs in order to preserve present practice, only the one factory now using that particular design would be affected, for the committee were not able to find that any two factories were using exactly the same design. It may be said, however, that probably more than half of the nearly one hundred designs referred to approximate in most particulars one of the designs shown in the 4-b table.

While the four-spline practice at the present time is used almost exclusively in connection with transmission shafts and as the resulting design shown in the 4-b table corresponds very closely in capacity to the 6-b and the 10-a tables already approved, the committee thought it desirable to show also a set of four-spline designs suitable for permanent fittings and corresponding in capacity to the 6-a table already approved.

Referring to paragraph 1 of the "Advantages of Unequal Division" referred to above, the committee offers herewith a suggested design of shaft. In the proportions given, the circumferential bearing surface of the large diameter and small diameter are approximately the same; in other words, the design is equally suitable for carrying the weight of the gear or other corresponding parts on the large or on the small diameter.

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The design of the broached holes permits of a shaft of this design or of the heretofore usual design which does not include the auxiliary grooves. The proportions shown for the grooves may of course be modified to suit each engineer's design and factory manufacturing conditions.

The paragraph of the Sixth Report presented at the January, 1914, meeting in reference to "problems considered," "working limits," and "radii at corners" apply with equal force to this report and need not be repeated here.

Respectfully submitted.
BROACHES DIVISION,
C. W. SPICER,
Chairman.

Submitted for Discussion—Not in Effect Until Accepted by Society of Automobile Engineers

SECOND REPORT OF THE PLEASURE CAR WHEELS DIVISION

ROUTINE TEST OF RIMS

It is the opinion of the Pleasure Car Wheels Division that the test of bursting strength or to destruction is not the best routine test to be used in connection with the inspection of rims for pneumatic tires. It is the opinion of the Division that a pressure test with predetermined deflection under predetermined pressure is a good routine test; the test to be made with water pressure.

The measurement of deflection of a Clincher rim should be made across the outside of the clinches (dimension H in the drawing).

The deflection of a Straight-side rim should be measured across the edges of the straight sides (dimension H in the drawing).

A = maximum inside distance between tips of tire-retaining flanges
H = maximum outside distance between tire-retaining flanges.

Deflection should be measured from a fixed initial load of twenty-five pounds per square inch up to a predetermined maximum, the figures suggested for which at this time are as follows:

Section	Rim Size	Pressure, Pounds	Maximum Allowable Deflection	Total Permanent set after test. 25 pounds pressure
D	3½	140	.06″	.02″
E	4	160	.07″	.03″
F	4½	180	.10″	.06″

In conducting tests the measurement of deflection should be made after added increments of load of 20 to 25 pounds; and of the corre-

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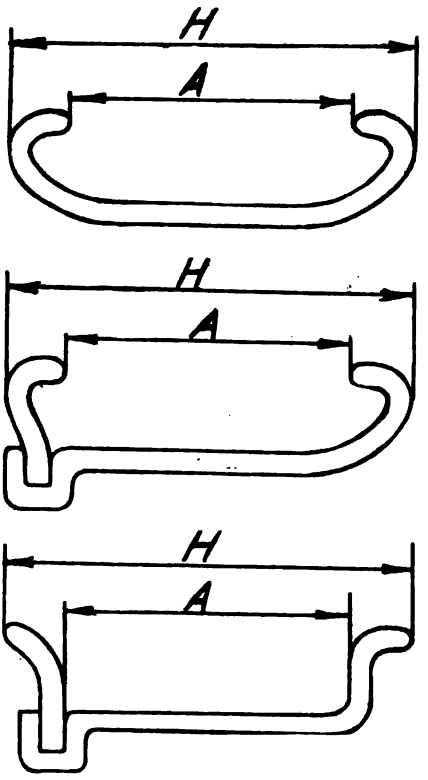

sponding set with the load released to the initial pressure of 25 pounds per square inch.

These figures of maximum allowable deflection and total permanent set, are the same as those contained in our report submitted to the Standards Committee last January. That report was referred back to the Pleasure Car Wheels Division at its own request as the Division wanted to be sure of, and reconsider some of, the points involved in the report.

During the year the Division has continued its tests on rims. There are given below curves plotted from the results of tests on some twenty-seven different rims which are specified by letters, the makers' names being omitted. The lines shown by the cross-marks indicate the danger points deduced from our above given recommendation for allowable deflection and permanent set. The lettered curves indicate the deflection and permanent set of the rims tested. The hydraulic method of testing was used. Regular size soft-bead clincher tires were used for clincher type rims, and inextensible, shaped-bead, straight-side tires were used for the straight-side type rims. Although the majority of tires used on clincher-type

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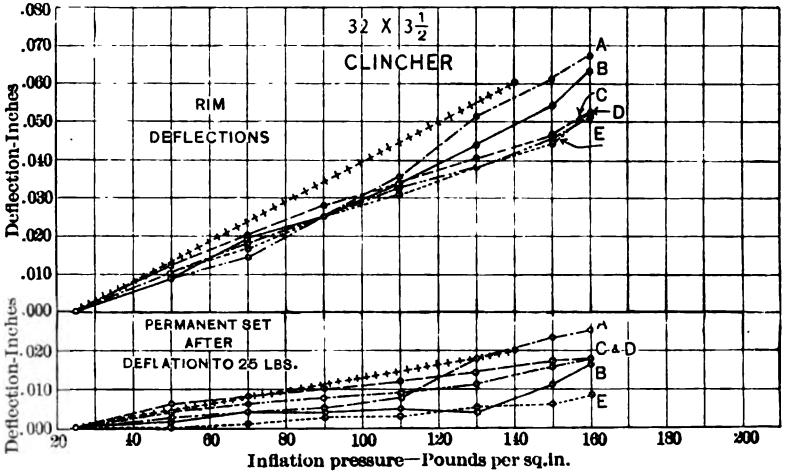

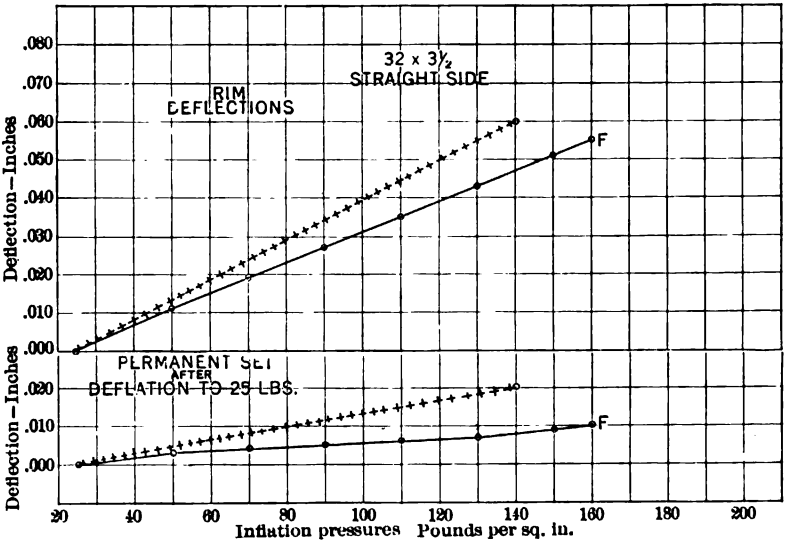

rims over 30 x 3½" size are so-called quick detachable clincher tires with partially or wholly inextensible beads, it was thought best to make the tests with soft-bead clincher tires in order to subject the rims to the hardest possible conditions that would ever be imposed in actual service. When Q. D. clincher tires are used the effect is less severe on the rim. The allowable deflection and permanent set were so chosen that a fair factor of safety was provided for the rims when oversize

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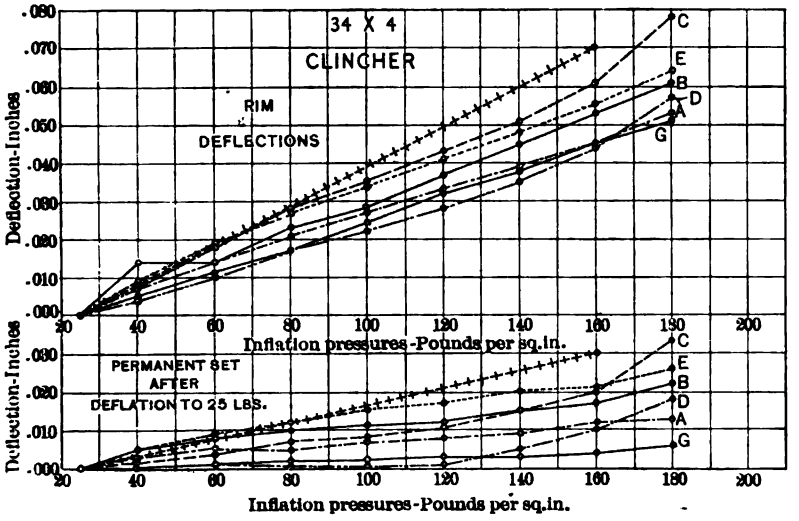

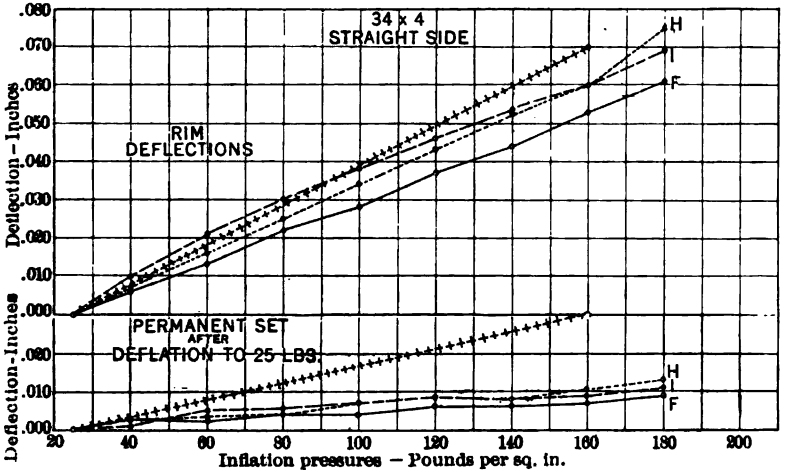

tires were used on them. The rims were not tested to the bursting strength, but simply to predetermined pressure.

The tests indicate that some of the 4½-inch rims needed strengthening. It is the view of the Division, however, after considering the above mentioned tests, that the figures recommended by it originally and above are justifiable.

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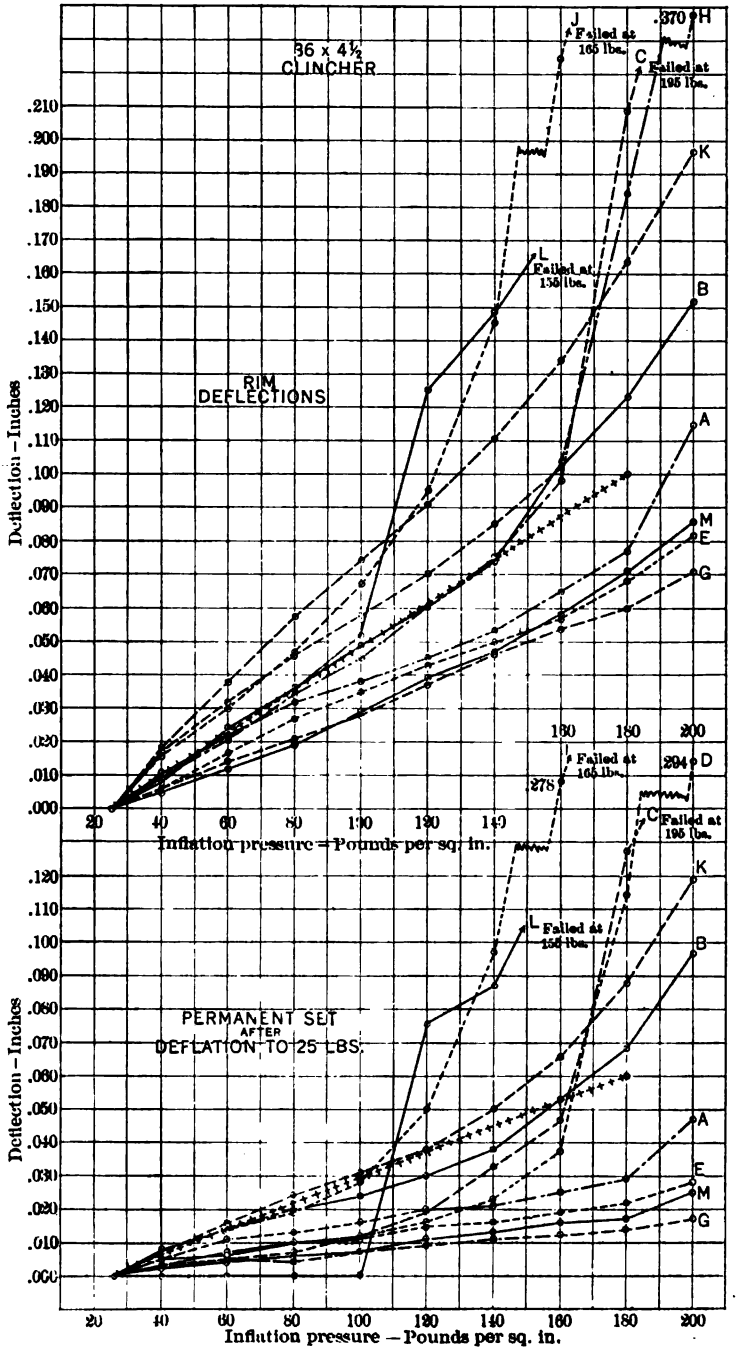
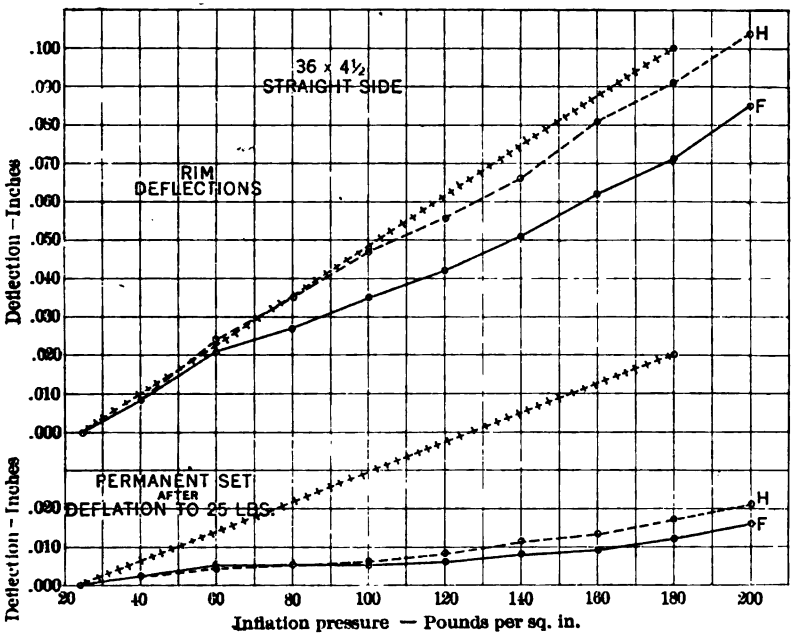

36 x 4½
CLINCHER
RIM
DEFLECTIONS
Deflection – Inches
Inflation pressure – Pounds per sq. in.
J
Failed at
165 lbs.
.370
H
C
Failed at
195 lbs.
K
L
Failed at
158 lbs.
B
A
M
E
G
180
190
200
278
204
D
PERMANENT SET
AFTER
DEFLATION TO 25 LBS.



TIRE SIZES

Eight tire sizes which the Division decided to recommend are shown in the following table:

Rim Sizes	*Tire Sizes*	*Tire Seat Diameter*
30 x 3	30 x 3	24"
30 x 3½	30 x 3½	23"
32 x 3½	32 x 3½	25"
32 x 4	32 x 4	24"
34 x 4	34 x 4	26"
34 x 4½	34 x 4½	25"
36 x 4½	36 x 4½	27"
38 x 5½	38 x 5½	27"

This table, it will be noted, involves only eight rim sizes, and five tire seat diameters. One or two other regular tire sizes are under consideration by the Division.

It was thought by the Division that tire oversizes should not be recommended for regular equipment.

Respectfully submitted.
PLEASURE CAR WHEELS DIVISION,
HENRY SOUTHER,
Chairman.

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Paper for Summer Meeting.

S. M. M. T. STANDARD RIMS

A CRITICISM

By E. R. Hall*

(Member of the Society)

Ever since the clincher type automobile rim has become popular in Great Britain and Europe a very chaotic condition has existed in millimeter rim design. Each manufacturer of millimeter rims had his own so-called standard design to which he worked and the result was that rims marked the same size and supposed to take the same tire differed widely in design. The tolerances which the rim manufacturers allowed themselves were so gross that there was oftentimes considerable variation between two rims of the same size and manufactured by the same manufacturer. This condition prevailed in spite of the fact that it is ruinous to a beaded edge or clincher type tire, such as is in general use abroad, to be used on a rim which it does not fit exactly. A great hardship was thereby worked upon the tire manufacturers who had to make the bead of their tire small enough to slide into the smallest rim of its rated size on the market, and to trust to luck for satisfaction in their product when used on the larger rims of its rated size.

The Society of Motor Manufacturers and Traders of Great Britain in June, 1913, standardized the millimeter clincher rim and later, in September, 1913, adopted a set of permissible tolerances to which the rim manufacturer should work. The society has produced a most complete set of rim checking templates, tapes and printed specifications covering their standard.

As far as we are able to determine, this standard, known as the S. M. M. T. standard, has been universally adopted abroad.

Although a very great step in the right direction and possibly the best that could be made at this time, the S. M. M. T. standard is open to criticism from the American viewpoint.

The S. M. M. T. standard is given below.

It will be noted that the two chief dimensions of the rim section are the width between clinches marked *A* and the depth of clinch marked *V* and that the majority of the other section dimensions can be expressed in terms of these two. As a matter of convenience and record this feature is admirable. The width of the rim, dimension *A*, was apparently chosen arbitrarily, as it does not increase in increments corresponding to the increase in rated rim size. Between any two of the first six sections the increase in rated size of rim and tire section is exactly 15 millimeters, while the corresponding increase in width, dimension *A*, is respectively as follows: 13.0, 11.0, 5.0, 9.5 and 13.5 millimeters.

*Experimental engineer, The Goodyear Tire and Rubber Company.

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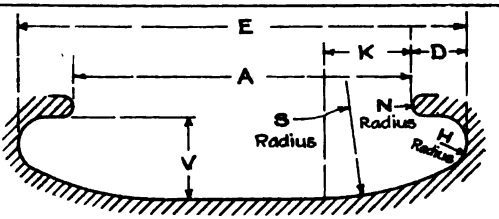
TABLE I



SIZE	WIDTH A	DEPTH V	EXTREME WIDTH, E A+1.4V	LENGTH OF HEEL, D .7V	RADIUS OF HEEL, R .326V	LENGTH OF SOLE, K 1.05V	RADIUS OF SOLE S	RADIUS OF ANCHORAGE N
65(or 75)	38.5	10	52.5	7.0	3.26	10.9	35.79	1.75
90	51.5	12	68.3	8.4	3.91	13.08	42.92	2.0
105	62.5	14	82.1	9.8	4.56	15.26	50.05	2.0
120	67.5	16	89.9	11.2	5.22	17.44	57.92	2.25
135	77.0	17	100.8	11.9	5.54	18.53	60.82	2.5
150	90.5	18	115.7	12.6	5.86	19.62	64.42	2.5
175	90.5	18	115.7	12.6	5.86	19.62	64.42	2.5

NOTE:-All Dimensions are in Millimeters

The increase in rated size between the 150 and 175-millimeter rim is 25 millimeters, while there is no increase in width, dimension *A*. We would have preferred to have this increase in *A* a constant quantity, possibly 10 millimeters, between any two consecutive sizes from 75 millimeters to 150 millimeters, inclusive, and the increase between the 150 millimeters and 175 millimeters sizes be *O* as at present. This would certainly give a more uniform and logical step-up in tire sectional sizes, provided the tires were made any where near rated size.

Dimension *V* or depth of clinch increases by very small increments as the rim size increases, not more than 2 millimeters in any case. As these differences are so small, and in view of the fact that the tolerances prescribed permit them to entirely disappear and in some cases overlap (as will be noted below), we would prefer to see dimension *V* equal 13 millimeters for both 90- and 105-millimeter rims and 16 millimeters for 120- and 135-millimeter rims. This would give only four different inside rim contours instead of six as at present prescribed, making it necessary for the rim manufacturer to have only four sets of contour rolls instead of six, thus cutting down the forming roll equipment 33 per cent. (Difference in width between any two rims of the same contour can be taken care of where necessary by using blank spacer rolls in rolling.) Under these conditions the rims should fit the tires exactly as satisfactorily as in the case of the present standard. With the changes as above outlined the table of standard dimensions of the rim sections would appear as shown in Table III.

Referring to the diameter and circumference table, Table II, as standardized there appears to be but very little difference (approximately 6 millimeters) between the 90- and 105-millimeter circumferences, com-

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TABLE II				
RATED RIM SIZE	TIRE SEAT CIRCUMFERENCE		TIRE SEAT DIAMETER	
	MILLIM'RS	INCHES	MILLIM'RS	INCHES
650 x 65	1600	62.992	509.3	20.051
700 x 65	1740	68.504	553.86	21.805
750 x 65	1870	73.622	595.24	23.435
710 x 90	1620	63.780	515.66	20.301
760 x 90	1760	69.291	560.22	22.056
810 x 90	1930	75.984	614.34	24.186
870 x 90	2125	83.661	676.41	26.630
910 x 90	2250	88.583	716.20	28.197
1010 x 90	2575	101.378	819.65	32.269
765 x 105	1755	69.094	558.63	21.993
815 x 105	1924	75.748	612.43	24.111
875 x 105	2119	83.425	674.50	26.555
915 x 105	2244	88.346	714.29	28.122
820 x 120	1780	70.079	566.59	22.307
850 x 120	1880	74.016	598.42	23.560
880 x 120	1980	77.953	630.25	24.813
920 x 120	2100	82.677	668.45	26.317
895 x 135	1855	73.031	590.46	23.247
935 x 135	2011	79.173	640.12	25.202
900 x 150	1904	74.960	606.06	23.861
1000 x 150	2215	87.205	705.06	27.758
915 x 175	1581	62.244	503.25	19.813
965 x 175	1800	70.866	572.96	22.557

paring the 810 x 90 and the 815 x 105, the 870 x 90 and the 875 x 105, etc. It appears practicable to make these corresponding 90- and 105-millimeter rims of the same circumference, thus permitting over-size tire equipment with the regular standards size tires, enabling the use of an

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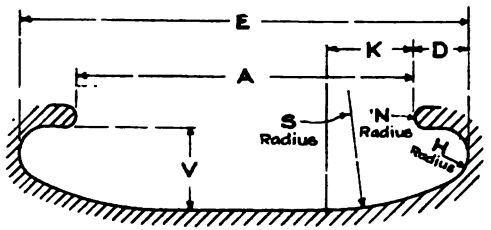
TABLE III



SIZE	WIDTH A	DEPTH V	EXTREME WIDTH, E A+1.4V	LENGTH OF HEEL, D .7V	RADIUS OF HEEL, H .326V	LENGTH OF SOLE, K 1.09V	RADIUS OF SOLE S	RADIUS OF ANCHORAGE N
65 & 75	38	10	52.0	7.0	3.26	10.9	35.79	1.75
90	48	13	66.2	9.1	4.24	14.17	46.56	2.0
105	58	13	76.2	9.1	4.24	14.17	46.56	2.0
120	68	16	90.4	11.2	5.22	17.44	57.32	2.5
135	78	16	100.4	11.2	5.22	17.44	57.32	2.5
150 & 175	88	18	113.2	12.6	5.87	19.62	64.46	2.5

NOTE:-All Dimensions are in Millimeters

815 x 105 standard tire on an 810 x 90 rim, etc.—a feature of untold value to car users. The differences in circumference are too great between the various other sectional sizes to allow of any further combination of this sort. We feel, however, that in the interest of reduction of the number of sizes the circumferences of the 900 x 150 and the 915 x 175 should be the same and the 1,000 x 150 and 965 x 175 should be the same, even though the nominal sizes are very diversified, thus giving only two rims to take care of these four tire sizes.

It will be noted that these circumferences do not follow any law or direct relation to the tire section, as is the case with the American standard. As an example of American practice, take a 34 x 4 tire. The tire seat circumference of the rim is 81.682 inches, giving a diameter of 26 inches. This is equal to the nominal tire diameter (34 inches) minus twice the nominal tire section diameter (4 inches).

$$\frac{81.682}{3.1416} = 26 = 34 - (2 \times 4)$$

The S. M. M. T standard could be very much improved if it were possible to lay it out to some such law.

The above criticisms and suggestions are entirely from the American viewpoint. We must admit that the S. M. M. T. standard as it stands is a very great improvement over former conditions, and is probably the very best that could be attained under the circumstances. Credit is due the Society of Motor Manufacturers and Traders for causing the adoption of an admirable rim section contour comprising excellent proportions, bearing the same relation to each other in all sizes. In this particular their standard is certainly better than the American standard.

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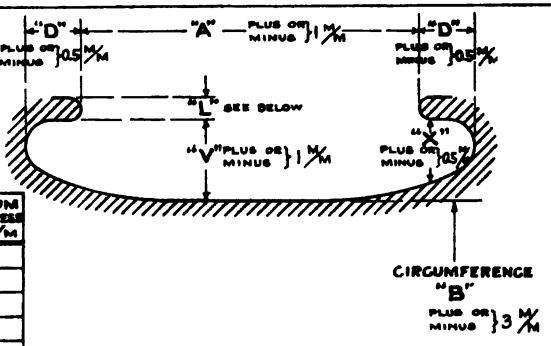
It is improbable that any of the improvements to the S. M. M. T. standard suggested above could be incorporated at this time. For this reason we favor its universal adoption in its present form, excepting tolerances (which see below).

The tolerances specified by the S. M. M. T. standard are so great that they almost entirely defeat its purpose from the American standpoint. Accustomed to rims manufactured with a very high degree of precision and to very close tolerances, the American tire manufacturer designs his tire to give an ideal fit on a rim exact to standard and he is sure the tire will fit practically as perfectly in a maximum or minimum rim of its size. If a tire is made to fit a correct S. M. M. T. standard rim as perfectly, the tire cannot be made to enter a minimum rim and will float around and be a very poor fit in a maximum rim.

The S. M. M. T. standard tolerances follow:

TABLE IV



SIZE M/M	MINIMUM THICKNESS "L" M/M
65 (or 75)	3.0
90	3.0
105	3.0
120	3.5
135	4.0
150	5.0
175	5.0

Combining Table I and IV above we can compile Table V, giving maximum and minimum section dimensions:

This table shows an overlapping of sizes in a number of cases. For example, for a 120-millimeter rim *V* maximum equals 17 millimeters and *D* maximum equals 11.7 millimeters, while for a 135-millimeter rim *V* minimum equals 15 millimeters and *D* minimum equals 11.4 millimeters. Yet in a properly designed 120-millimeter tire bead *V* is 1 millimeter less and *D* is 0.7 millimeter less than in the case of a 135-millimeter tire bead. In Table IV above the circumferential tolerance is 3 millimeters or a total tolerance of 6 millimeters. This large tolerance would cause a hardship in the use of inextensible bead tires similar to the majority of tires used in America in connection with quick detachable type rims to the S. M. M. T. standards. On a maximum rim the tire would be extremely hard to apply and on a minimum rim it would fit very loosely, having a tendency to creep, making it always necessary

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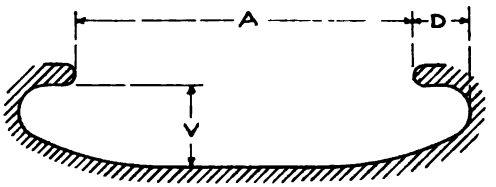
TABLE V



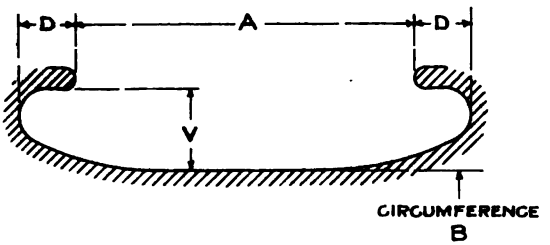
SIZE	A		V		D	
	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM
65 (or 75)	39.5	37.5	11	9	7.5	6.5
90	52.5	50.5	13	11	8.9	7.9
105	63.5	61.5	15	13	10.3	9.3
120	68.5	66.5	17	15	11.7	10.7
135	78.0	76.0	18	16	12.4	11.4
150	91.5	89.5	19	17	13.1	12.1
175	91.5	89.5	19	17	13.1	12.1

NOTE:-All Dimensions are in Millimeters

to use flaps to keep the inner tube from being pinched between the tire bead and the rim.

Below is a table showing a comparison between S. M. M. T. and American standard rim tolerances given in both inches and millimeters.

TABLE VI



DIMENSION	S.M.M.T. STANDARD		AMERICAN STANDARD	
	MILLIMETERS	INCHES	MILLIMETERS	INCHES
A	±1.000	±0.039	±0.381	±0.015
B	±3.000	±0.118	±1.168	±0.046
D	±0.500	±0.020	±0.203	±0.008
V	±1.000	±0.039	+0.203 −0.000	+0.008 −0.000

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As will readily be seen there is a marked difference, the American tolerances being very much closer and correspondingly more satisfactory.

American rim manufacturers find it no hardship to work to these American tolerances and there are no rims applied to cars in America to-day which are not rigidly inspected and passed within these tolerances. The closer tolerances permit of more accuracy in tire design and resulting better fit of the tire in the rim, which in turn results invariably in improved tire service—the ultimate goal in all rim standardization.

We see no reason why the American tolerances without change cannot immediately be adopted in connection with the S. M. M. T. standard and so make of it, to all concerned, a more real and much more valuable standard.

Paper for Summer Meeting.

AN ENGINEERING BASIS FOR TAXATION OF MOTOR VEHICLES

By C. O. Egerton* and S. I. Feketet
(Members of the Society)

Within the last ten years the highway builders of this country and Europe have been compelled to make radical and costly changes in their methods of road construction. That these changes have been occasioned largely by the introduction of automobile traffic is undeniable, for the problem of economic construction and maintenance of roads for horse-drawn vehicles was satisfactorily solved approximately a century ago by English and Continental road builders.

But because automobile traffic has destroyed roads which successfully sustained animal-propelled vehicles, let us not indict it with wanton destruction of property until its side of the case has been fairly presented. If we were to take a typical automobile and a typical horse and wagon of equal weight and move them over parallel stretches of equally good roads at equal speeds until the road surfaces were no longer fit for economical use, we would probably discover that the roads would wear out at very nearly the same time. If one road lasted longer than the other, it would quite possibly be the road traversed by the motor car.

Actually, then, the cause of the increase in road destruction is due in the first place to the speed at which the motor car can move as compared with a horse and wagon; and in the second place to the increased volume of automobile traffic as compared with animal traffic. The cause for the former popular demand for a specific automobile tax

*Designer, Hudson Motor Car Company.
†Hudson Motor Car Company.

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arose probably from the fact that the motor car when first introduced was considered a luxury, while the horse and wagon have been regarded as necessities from time immemorial. At the present day, however, this distinction is certainly obsolescent if not obsolete. While it is essentially illogical that horse-drawn vehicles should be exempt from specific taxation, when they undoubtedly do their share of road damage, it is nevertheless a fact that motor vehicle users are the staunchest supporters of road extensions and maintenance, as well as the greatest beneficiaries therefrom, and as such should not escape a reasonable share of the expense so entailed, whether the cost is levied as a specific motor car tax or as one upon personal property. Assuming then that the motor car owner is to pay a reasonable tax, the amount of his contribution should be in direct proportion to the amount of damage which his vehicle is capable of inflicting upon the road surface.

CLASSIFICATION OF ROAD-DESTRUCTIVE ELEMENTS OF A MOTOR VEHICLE

The amount of damage which a vehicle can inflict upon a road is fundamentally dependent upon its weight and its velocity, but in order to better study these elements we must dissect them as far as possible.

The destructive power of weight alone upon a given type of road surface may be summarized as follows:

1. It is proportional to the pressure per square inch of tire contact.
2. It is dependent upon the character of contact, i. e., whether metal, solid rubber, or pneumatic tires are used.
3. It is inversely proportional to the contact diameter of the wheel.

The destructive power of velocity in conjunction with weight upon a given type of road surface is proportional to the linear distance which the point of road contact progresses in a unit of time which is, of course, directly dependent upon the capacity of the motor.

In other words, combining both elements of weight and velocity the destructive capacity of a motor vehicle is dependent upon the resistance encountered due to contact of various types of wheels with road surfaces at various speeds.

To set forth as clearly as possible the state of equilibrium existing between the forces producing and the forces consuming the vehicle's energy, let us suppose that we have in a convenient place on the moving vehicle two indicators. Let us say that the first indicator registers the speed of the car. The second indicator registers the horsepower acting through the drive wheels at the speed shown by the speed indicator. If now we start the car and gradually increase the speed until we are unable to make our speed indicator register any increase of velocity, we shall arrive at the conclusion that the power registered at that speed by our power indicator is being entirely consumed in overcoming external forces acting upon the car.

SOURCES OF EXTERNAL RESISTANCE

The external forces which prevented increase of speed in our supposed car are two in number, and are

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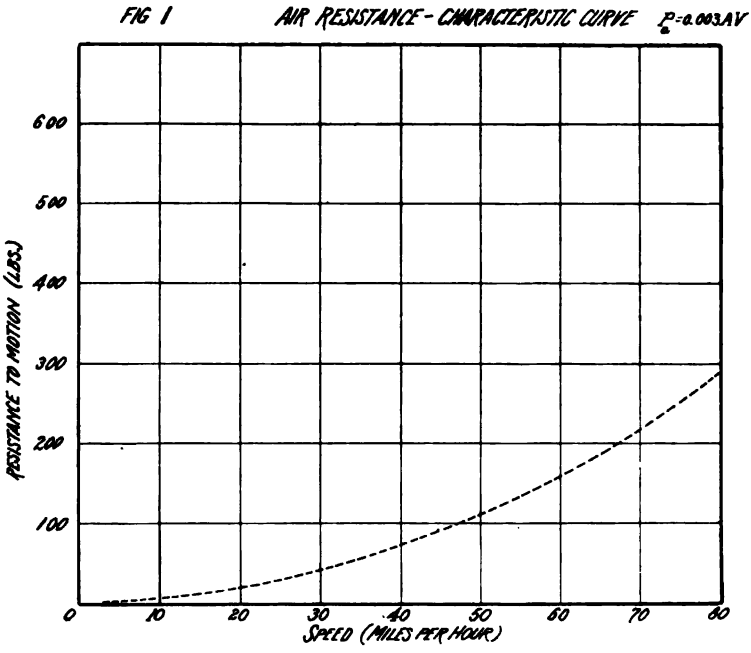
1. The resistance which the surrounding air offers to being displaced by the moving car.
2. The resistance which the road surface offers to being displaced by the wheels of the moving car.

Let us consider the general characteristics of these two resistances.

AIR RESISTANCE CHARACTERISTICS

The work required to move a vehicle against air resistance is proportional to the area exposed and proportional to the square of the velocity at which the vehicle moves. If we plot as a curve the work required to overcome air resistance, using for abscissæ the velocities of the moving vehicle in miles per hour, and for ordinates intensity of pressure at each velocity, the curve will be similar to that shown in Fig. 1.



ROAD RESISTANCE CHARACTERISTICS

According to the theory of rolling friction, a body passing over a surface produces a depression in that surface. The depth of this depression depends upon the relative hardness of the surface and that of the body.

The force required to produce motion in the above rolling body varies directly as the pressure between the body and the surface; directly as one-half the chord of the arc of depression; and inversely as the radius of the rolling body.

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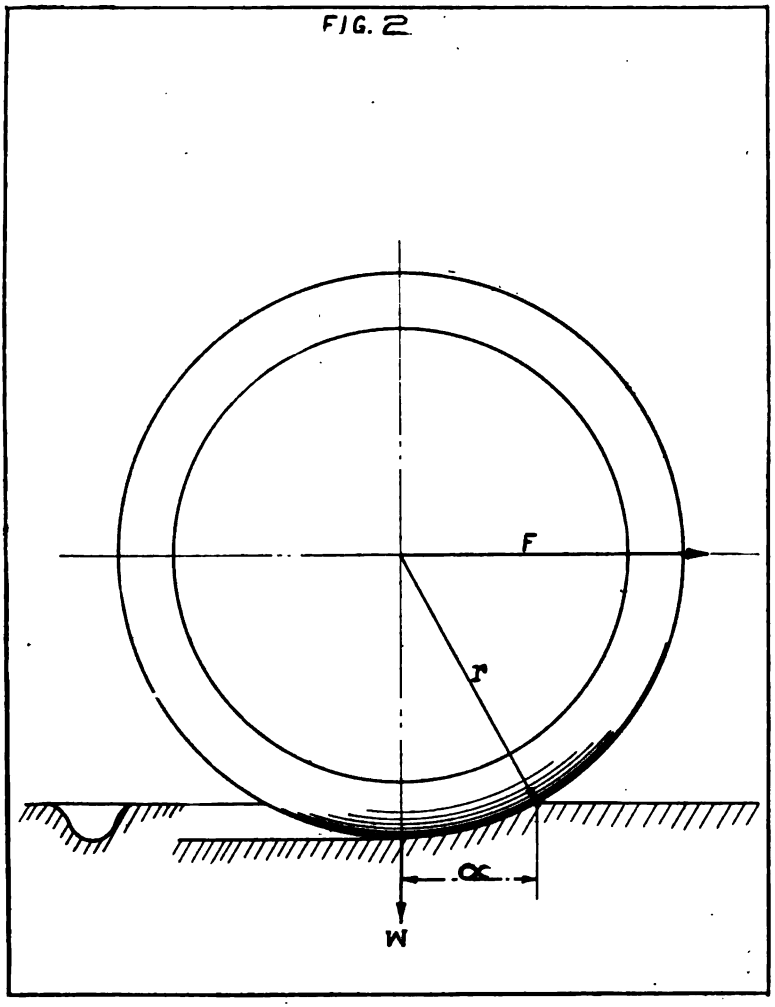
FIG. 2



Referring to Fig. 2,

$$F = \frac{W\,\alpha}{r} \qquad (1)$$

$$\alpha = \frac{F}{W} r \qquad (2)$$

W = Weight in pounds upon wheel.
F = Force in pounds to produce horizontal motion.

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$r = \frac{1}{2}$ diameter of wheel.
α = Coefficient of rolling friction.

In this equation the fraction $\frac{F}{W}$ represents nothing else than the force per pound of weight required to cause rolling motion.

The magnitude of the fraction $\frac{F}{W}$ may be accurately determined experimentally for the various combinations of road surfaces, types of tires and wheel diameters in common use at known speeds. Let us suppose we have determined by means of draw-bar dynamometer or by retardation the value of $\frac{F}{W}$ required to move various diameters of wheels equipped with a certain kind of tire over one class of road surface at known speeds. Having done this we may from equation (2) compute the values of α for various sizes of wheels for each possible combination of tires and road surfaces. The results of the foregoing computations may then be tabulated; a separate table being made for each combination of tire and road surface and each table giving the value of α corresponding to various possible diameters of wheel.

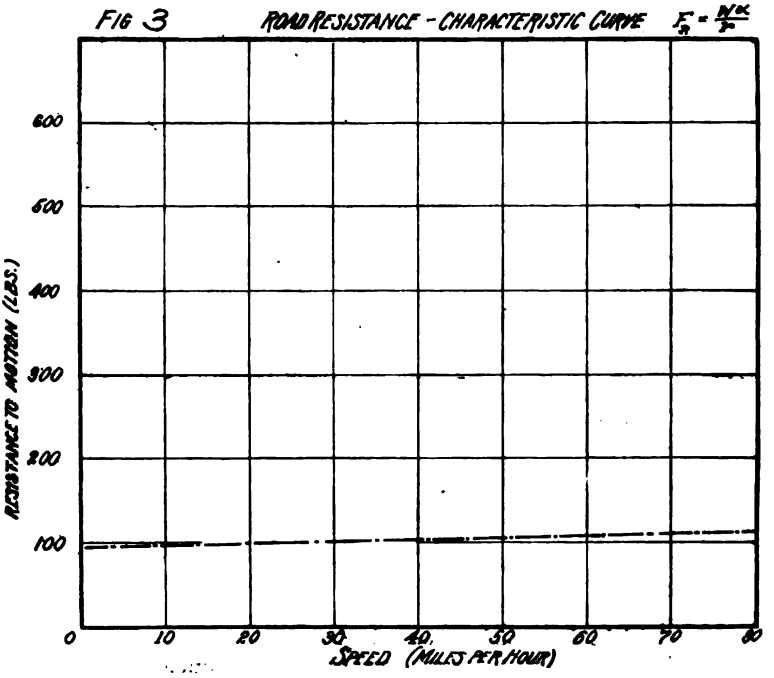

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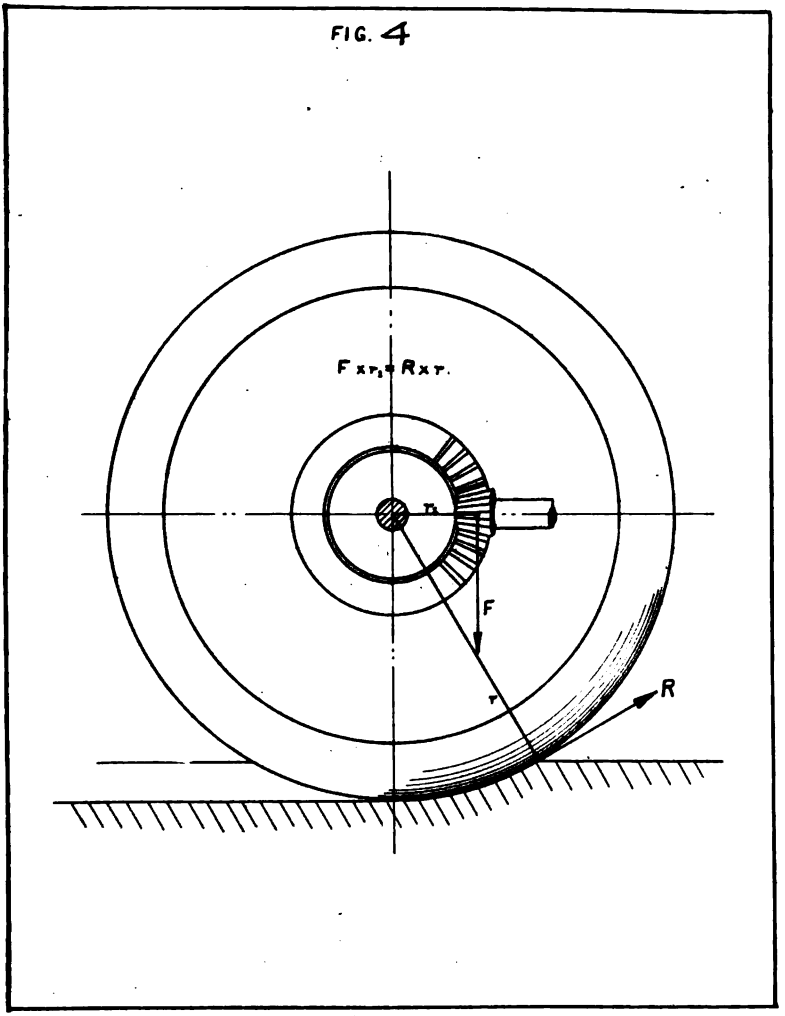
FIG. 4



If we plot a curve representing the work required to overcome road resistance, using for abscissæ the velocities of the moving vehicle in miles per hour, and for ordinates the magnitude of the tractive effort F which will be required to overcome the force caused by road resistance at that velocity, we will have a curve similar to that shown at Fig. 3.

The force F is in effect that which would be directly exerted by a horse in dragging a vehicle.

In our case we must instead deal with a force tending indirectly to produce horizontal motion by rotating a wheel. In other words, we have a mechanical couple composed of a force F tending to rotate the

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wheel through the medium of a gear or sprocket; opposing the road resistance R applied at the tread of the tire. (See Fig. 4.)

Instead, therefore, of pure rolling action we have a combination of rolling over the road surface and a tangential force acting between the tire and the road surface.

There will be two stages of the tangential phase: First, when the torque rotating the wheel is less than the torque due to the adhesion between the tire and road. Second, when the torque rotating the wheel is more than the resisting torque due to adhesion between the tire and road. In other words, the two stages are when the tire does not slip and when it does slip.

HYPOTHETICAL ACTION OF WHEELS UPON ROAD

There are three general classes of road surface to which we should give consideration in regard to their behavior under the action of wheels.

The first class, such as brick and concrete, which show comparatively little deflection under the action of rubber tires.

The second class, such as asphalt, macadam, and bituminous macadam, which show some noticeable depression under wheel action.

The third class, such as gravel, earth and sand, which show very considerable depression under wheel pressure.

In other words, the surfaces are classified according to the approach of their materials toward theoretically perfect elasticity.

ROADS OF HARD MATERIAL

If we take the case of a concrete road or one of brick supported upon a concrete foundation, we have a condition closely resembling that of a beam uniformly supported from below and acted upon from above by repeated stresses. By simply making the depth of concrete sufficient the section subjected to stress will be able to sustain an almost infinite number of deflections without fracture. Consequently it would appear to be a practical impossibility to destroy an adequately constructed concrete road by rolling a loaded wheel over it.

If destruction exists, then it must be due principally to the abrasive action of the rolling body. Abrasive action being purely a function of the relative hardness and relative speed of the rubbing surfaces, it is obvious that an ordinary steel wagon-tire can do much more damage than a rubber tire for the following reasons:

A concrete surface consists actually of an almost infinite number of minute particles of sand and rock which project very slightly above the cement matrix in which they are embedded. The abrasive action therefore consists in either dislodging these from their bed or in crushing them. A rubber tire clearly cannot crush these particles, for being so much softer it is merely depressed by them and dislodgement while not impossible is improbable since it would be liable to occur only when the tire has in addition to its rolling motion a slip relative to the road surface. Below the average legal limit of speed this slippage has been shown to be so small as to be almost negligible. (See deductions of

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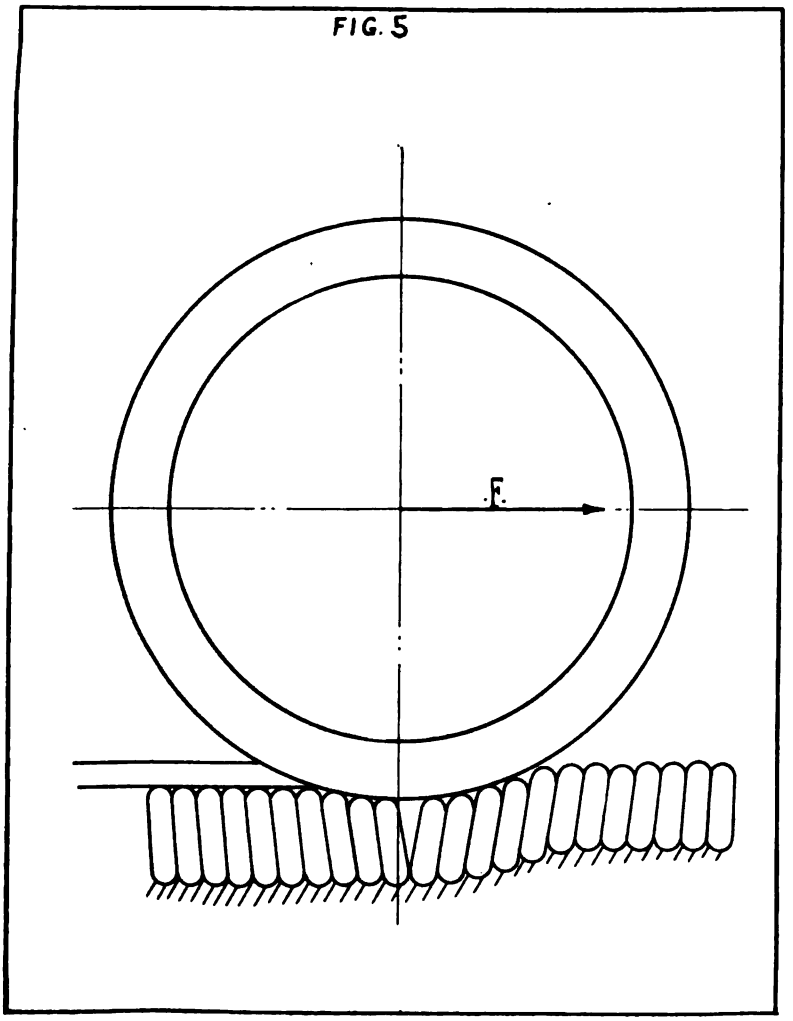
Henry Souther on Tire Slippage at Brooklands Race Track, S. A. E. Data Sheets.)

A steel tire in passing over projecting particles, however, has by virtue of its hardness the power to crush them. They then become powder, which is removed by wind, weather or other passing vehicles, leaving other similar particles exposed to subsequent similar action.

FIG. 5



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ROADS OF MEDIUM HARD MATERIAL

Let us suppose the second class of road surfaces is composed of a layer of short vertical rods fitting into sockets at their lower ends to allow oscillation in the direction of progression (see Fig. 5). The displacement of these rods as the wheel passes over them will be as follows: First, the rods ahead of the wheel are deflected in the direction of progression. Second, at some stage of the passage of the wheel the tangential component force due to the drive of the wheel becomes greater than the normal component due to the weight carried, with the result that a rod is deflected opposite to instead of in the direction of motion; thus creating or tending to create a space between it and its neighbor.

If, instead of independently acting rods, we have a surface layer composed of small crushed stones held together only by some adhesive compound, either a rupture or a severe strain is certain to occur at the point of deflection reversal.

With a substance possessing theoretically perfect elasticity the amount of work necessary to produce fracture of a given section is of course a fixed quantity; and the fracture may be produced either by applying a force of great intensity for a short time or by applying a small force for a long time.

A road surface composed of macadam held together by a bituminous binder is far from possessing perfect elasticity, so that while the viscous properties of the binder may reunite the particles of stone after a strain has been produced by a slowly acting force, it is reasonably certain that a suddenly applied force will completely rupture the continuity of the binding compound.

The power to produce this rupture is then clearly a function of the velocity with which the neighboring particles are separated and hence proportional to the velocity of the vehicle.

This tendency to break the continuity of the road surface is, however, only the first stage of the destruction. The second stage is reached when the speed of the vehicle is such that there is appreciable slippage between the tire and the road surface. The particles which have become loosened by the first stage of the process or during the passage of some preceding vehicle are then actually extricated from their place in the surface by contact with the tire which then has motion relative to the road surface instead of merely rolling over it.

ROADS OF SOFT MATERIAL

In the case of road surface composed of yielding material, such as sand, gravel or earth, having no extraneous material to bind its particles together, the particles subjected to pressure from a wheel are displaced until brought to rest by the friction between neighboring particles. If we assume a static condition of a wheel resting upon such material, it will resemble that shown in Fig. 6. Suppose further that the material is composed of small, nearly uniform spherical particles. As the load of a wheel is applied acting through the resultant W to one particle of the upper surface, this particle is depressed, and as it moves downward it divides

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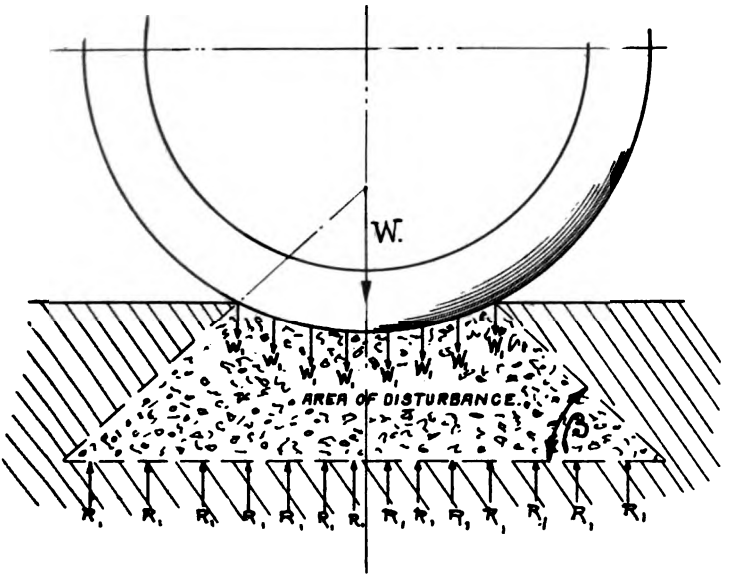
FIG. 6



the pressure between two particles beneath it. These two in turn divide the pressure between three, and this process continues downward until the pressure has been distributed among so many particles that each particle no longer has sufficient pressure upon it to produce motions in its neighbors.

In other words, a state of stable equilibrium has been reached. Of course, instead of one particle being in contact with the tire, its weight is distributed in small increments like W_1 (Fig. 6), which are resisted by uniformly distributed small increments R_1 (Fig. 6), but the process of weight distribution is essentially as described and we have formed beneath the tire a cone-shaped mass. The sides of the cone make the angle β

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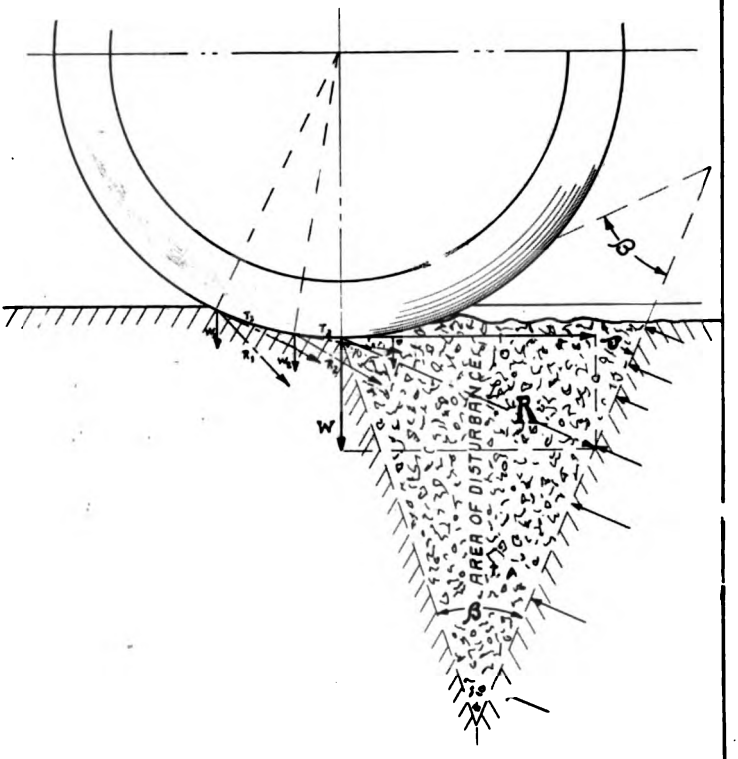
FIG. 7.



with the base, which is, in fact, the angle of repose for the material under consideration. Such is the condition under static load.

Supposing now that we have the wheel progressing at a considerable velocity and at the same time exerting a turning effort against the road surface, we will have a condition similar to that shown in Fig. 7. We must now deal with a resultant pressure on our hypothetical cone, the direction of which is no longer vertical but deflected toward the rear of the moving vehicle. The pressure in question is the resultant of the combination of weight on the moving wheel with a tangential component due to the torque which produces rotation in the wheel. What we find,

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therefore, is that the axis of the cone is no longer vertical, but takes such an angle that the rear surface of our cone-shaped mass approaches or passes a horizontal line at the road surface. As long as the cone

There are three general classes of road surfaces to which we should remained with its axis vertical there was sufficient mass of particles surrounding it to prevent any upheaval, but with the inclined position some of the stressed particles in the area of disturbance are exposed. The result is that there is an actual upheaval or wave formed behind the wheel. Because of this wave there is a displacement of material from the road surface.

It should be noted here that the same power of wave formation exists in the case of a horse-drawn vehicle, the only difference being in degree and direction of propagation of the wave. The horse-drawn vehicle propagates its wave ahead of instead of behind it, due to the fact that the friction of the wheel hub on the axle sets up a resistance to rotation which is balanced by a force acting between the tire and the road surface.

The conclusion we may draw from the analysis, however, is that the power as well as to some extent the velocity of the vehicle is instrumental in destroying the soft type of road surface. Perhaps the most perfect engine of destruction ever devised for this class of road is the horse-drawn buggy with an extremely narrow steel tire which cuts into the road surface with all the speed and effectiveness of a thin knife, leaving a rut which is augmented by succeeding vehicles with even normal tire widths. The action of tires having excessive pressure per unit of contact surface is therefore abnormal and will not be included in our analysis.

A potent factor in destruction of both soft and medium-hard roads is the action of a car as it passes rapidly around a curve. In this case the tendency of the tire to skid under the action of centrifugal force is proportional to the square of the velocity of the car and the radius of the curve upon which the car turns. The point we wish to bring out, however. in this connection is that the velocity of a vehicle is a considerable factor in the destruction of all classes of roads, and that for a given type of tire the coefficient α will differ for each type of road.

RELATIONSHIP BETWEEN POWER AND RESISTANCE

Now that we have noted the effect of resistance to car velocity upon road surfaces, let us next look into the general relation of power to resistance. In Fig. 1 we plotted a curve which expressed the magnitude of the force set up by the air resisting the passage of a vehicle moving at various speeds. In Fig. 3 we plotted a curve which expressed the magnitude of the force set up by the road surface resisting the passage of a wheel moving at various speeds. The total resistance encountered by the car is. therefore, equal to the sum of the two individual resistances. In both Figs. 1 and 3, the scale of abscissae and ordinates was the same, so that if we wish to express graphically the magnitude of the total resistance to motion of a moving vehicle, we may do so by plotting on the same scale of co-ordinates a curve, the ordinate of which at any given speed is equal to the sum of the ordinates for each of the characteristic

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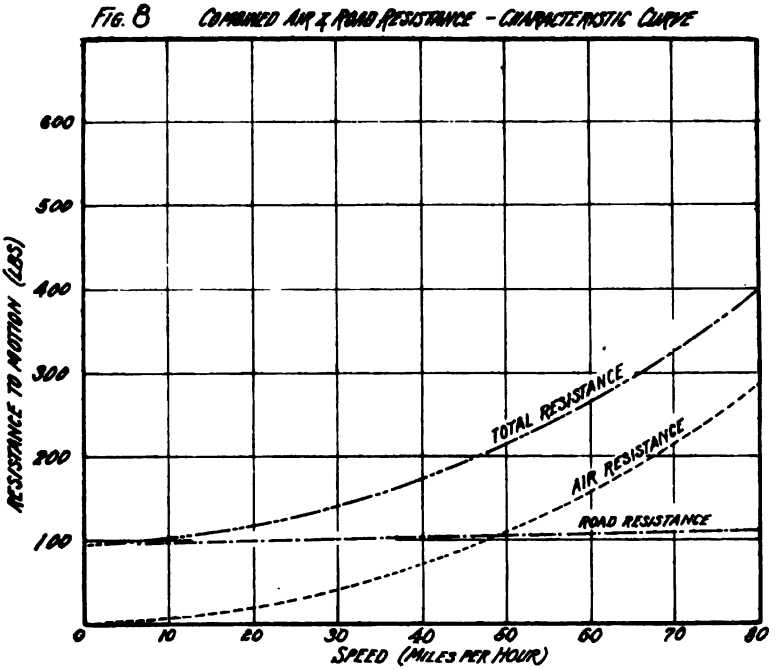

curves at that same speed. Fig. 8 shows such a curve. The work by which we overcome the work due to total resistance, represented by the area under the combined resistance curve (Fig. 8) is nothing else than the work delivered at the rear wheels by the motor acting through the medium of the transmission system.

Suppose that we plot upon the same system and scale of co-ordinates, a curve, the ordinate of which at any given speed is equal to the magnitude of the force propelling the aforesaid vehicle. Then assuming that our horsepower is of constant magnitude it will be represented by a curve shown in Fig. 9.

As a means of comparing this latter with our total-resistance curve, let us superpose one upon the other, keeping our base line and origin coincident as in Fig. 10. Near the point of zero velocity the ordinates of the propelling-force curve are much higher than those of the total-resistance curve. The ordinates of the total-resistance curve, however, increase as we move toward the right until we finally reach a point at which the ordinate is equal to the ordinate of the propelling-force curve for that velocity.

The significance of this coincident is that at this velocity the propelling and resisting forces are exactly in equilibrium, and that this velocity may be maintained but cannot be exceeded. If we consider a vehicle of the same mass as the one just mentioned, but impart to it a propelling force equal to only one-half that of the first body, then clearly

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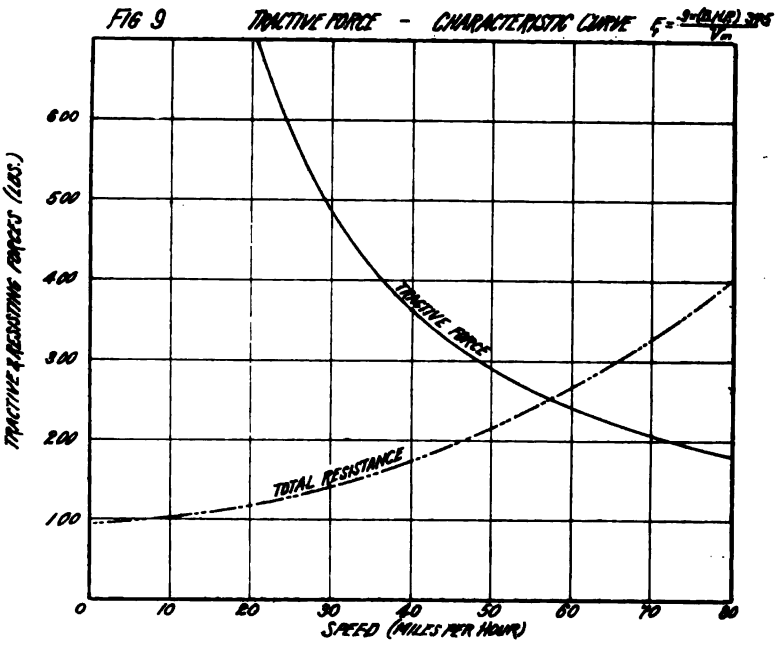

the curve of propelling forces will intersect the curve of total-resisting forces at a point much nearer the zero velocity than was the case with the first body. Hence, maximum possible velocity is proportional to propelling force.

Should we wish now to pass from a consideration of propelling and resisting forces to a consideration of work required for propulsion and resistance, we may do so by comparing the areas under the plotted curves. From such comparison we shall see that from the point where the curves of propulsion and resistance intersect, the velocity will remain constant and its product by the ordinate at that point will be equal to the power required to maintain that velocity.

SYSTEM APPLICABLE TO ANY VEHICLE

The moving vehicle which has been under consideration might be either an animal or a mechanically propelled vehicle, and still be susceptible to the same treatment, but of course the power and resistance curves would present different characteristics. As an example, Fig. 11 shows the curves for a horse-drawn vehicle and a motor car. In the case of the horse-drawn vehicle the only resistance which we have to overcome is the road resistance. The line representing the propelling force is a straight line parallel to the base line and its distance above it is proportional to the number of horses pulling upon the vehicle.

LEGAL AND PRACTICAL LIMITS ON VELOCITY

Nearly every State in the Union imposes a limit upon the speed at which

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FIG 10 DESTRUCTIVE WORK ON ROAD.

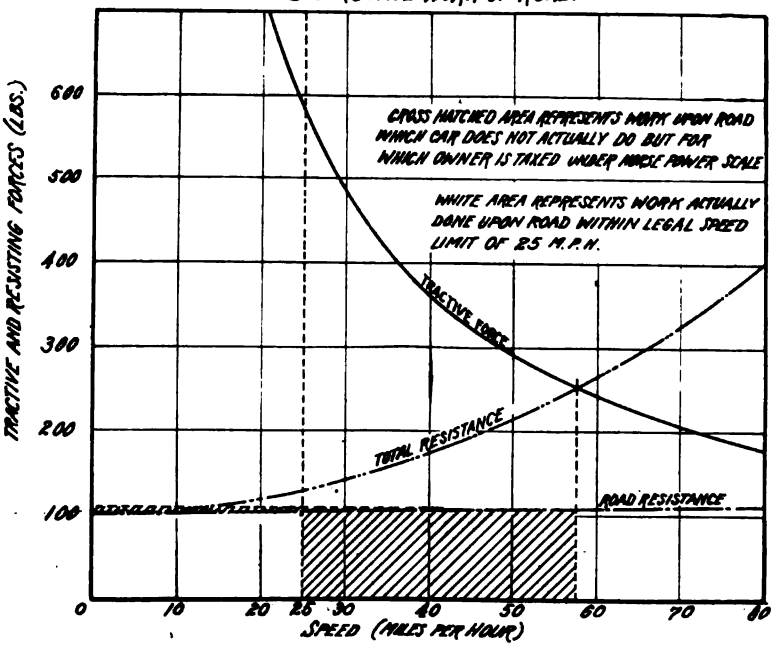
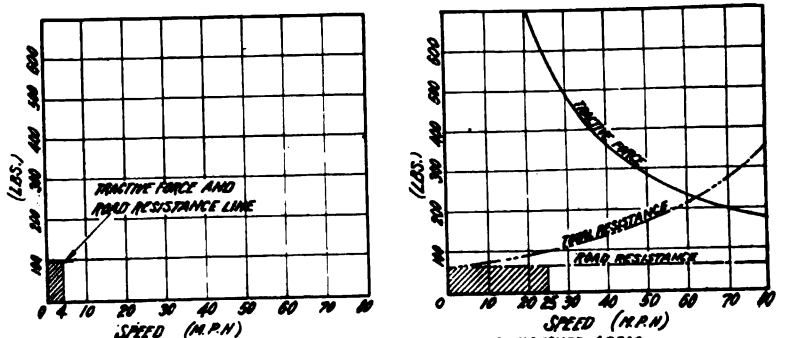


FIG 11 WORK DONE UPON ROAD IN ONE HOUR BY HORSE AND WAGON AND AUTOMOBILE OF EQUAL WEIGHT.

ONE HORSE IN HARNESS. (HÜTTE) DEVELOPES TRACTIVE FORCE OF 99 LBS AT 4 M.P.H. WHICH IS ITS MAX. ECONOMICAL SPEED. 1½ TON WAGON HAS CONSTANT ROAD RESISTANCE OF 99 LBS. LINE OF TRACTIVE FORCE AND ROAD RESISTANCE THEREFORE COINCIDE AND THERE IS NO EXCESS POWER.

AUTOMOBILE ASSUMED TO TRAVEL AT AVERAGE SPEED OF 25 M.P.H.



WORK ON ROAD INDICATED BY CROSS HATCHED AREAS.

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a vehicle may travel over its roads. An average taken of the limits in thirty-eight States shows itself to be approximately 25 miles per hour.

In Vol. 1 of the S. A. E. Data Sheets is a table compiled by A. Churchward, giving ideal speeds in miles per hour for vehicles of various weights. A prefixed note says: "Taking everything into consideration, that is to say, life of engine, transmission, tires and maintenance of vehicle as a whole, experience has shown that the following table of economic speeds is approximately correct."

The speeds given in that table are lower than the average of the State limitations. If we consider that on our graphical representation of road resistance and tractive forces, our lines represent average relative conditions of power to road resistance, it is clear that an average automobile has sufficient power to exceed speed limits fixed either by law or by general expediency regarding life and maintenance of car. The question naturally arises at this point, therefore, why should we, as is now the general tendency, tax a man in proportion to the power of his motor when actually he must not only break the law to use the full power for which he is taxed, but also must shorten the life of his vehicle by so doing. It is quite presumable that with efficient police regulation a man cannot habitually or with impunity exceed fixed speed laws. Moreover, looking at a motor car as a pleasure vehicle, it is doubtful if the occupants of a car derive any genuine pleasure or benefit from speeds in excess of 25 miles an hour.

Looking at the subject from all angles, then, it is very doubtful if a conservative man cares to drive his car at a higher average speed than 25 miles an hour, so that the average of road resistance which we must consider will be that encountered at that speed. But as we have previously stated, the destructive effect of a vehicle on the road at a given speed is measured by the resistance encountered at that speed; so that our measure of the destruction which a car can cause to a road will occur at the legal speed which is 25 miles per hour.

Any road vehicle, then, should be primarily taxed in proportion to its road destructive power and hence in proportion to its road resistance at its allowable speed, and not at a speed in excess of that, even though the motor may be of sufficient horsepower to maintain a higher rate of speed.

HOURS PER DAY WHICH VEHICLES USE ROADS

It is not alone sufficient, however, that the vehicle should be taxed entirely in proportion to the Road Resistance. As is very evident, certain classes of vehicles use the roads a far greater number of hours per day, week, or month than do other classes, and the amount of work which they do in destroying roads is directly proportional to the relative length of time during which they are in motion on the roads.

The problem of determining an average of the number of hours per day spent by each class of vehicle on the roads is somewhat difficult. In this respect we will class vehicles under the heads of commercial and pleasure vehicles. Of the commercial vehicles, omnibuses use the roads the greatest number of hours per day. If we assume that they give

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continuous service (365 days per year) from six in the morning until nine at night, we shall be well within the actual limits of operation. This gives 15 hours per day during which they use the roads.

Motor trucks are the next in order of length of time per day, which, if we consider the average business day, will be about ten hours. Inasmuch as there are but about 300 working days per year, allowing for Sundays and holidays, the average as compared with omnibuses and pleasure cars will be $10 \times \frac{300}{365}$ hours, which makes a daily average of about 8¼ hours.

With pleasure cars the time factor is very indefinite. Let us assume that a man drives his car to and from his home and his place of business twice a day, and goes out for an hour's ride in the evening and spends about nine hours in his car on Sunday. The number of hours consumed in trips to and from work may be estimated at a maximum of 3 per day. Let us say that considering all seasons of the year, the man drives on an average one hour in the evening. Now adding in the 9 hours of Sunday driving we get a total of $18 + 6 + 9 = 33$ hours per week, and an average of 4¾ hours per day.

APPLICATION OF HOURS PER DAY FACTOR

If our assumptions have been approximately correct we must further modify our road resistance by discriminating between the different classes of vehicles, that is, omnibuses, trucks and pleasure cars in the proportion of 15, 8¼ and 4¾. That is to say, that if we regard the tax rate for pleasure vehicles as the basic rate, the rate for trucks will be about 1¾ times the basic rate, and the rate for omnibuses will be 3⅛ times the basic rate.

In justice to the road builder it would be well to establish lower limits of speed for vehicles of excessive weight per square inch of tire contact. This, in fact, has been done in some States, notably in Massachusetts and New York. At just what point these limits should be established could be determined by experimental means.

GENERAL CONCLUSIONS

After one has scrutinized the superposed characteristic curves of power and resistance and grasped the significance of the area representing work to the right-hand side of the line of 25-mile per hour velocity, he cannot but understand what a comparatively small portion of the average horsepower of a motor is actually used in doing destructive work on the road. And understanding this fact it would be logical to give consideration to some tax system bearing a more direct relation to road destruction than does the horsepower scale.

Such a mode of taxation would in no wise work injustice either to the State or to the vehicle user and would tax the user in proportion to the total yearly road destruction of his car at legal speed. This road destruction could be calculated by some formula which takes into account the various items of weight, wheel diameter and type of tires.

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While it is not entirely within the scope of this paper to derive such a formula, we may suggest one taking the general form here shown:

$$\text{Total tax} = \frac{W\alpha}{r} V_m \times K \times \text{Tax rate per unit.}$$

In this formula

W represents the total weight of car.

α = Coefficient of rolling friction.

$r = \frac{1}{2}$ tire diameter.

V_m = Legal velocity in miles per hour.

K is a factor proportional to the average number of hours per day which a given type of vehicle uses the road relative to the standard type on which the tax rate is based.

The value of α should be determined only after a series of exhaustive experiments.

To bring out more clearly the radical differences between the two systems of taxation, let us take a practical example.

Suppose we consider a touring car and a medium-capacity truck. The monetary value of each is about the same. The touring car has a motor of the same bore, stroke and number of cylinders. The touring car has pneumatic and the truck solid tires. Under the horsepower scale both vehicles pay the same tax. If they travel over a road at the same rate of speed, however, it is hardly probable that they do the same amount of damage, and yet for this damage both must pay equally.

On the other hand, if we taxed each vehicle in proportion to the destruction each might cause to the road, each pays only for its share of the destruction.

Which system of taxation appears then to be more logical; the one based on horsepower or the one based on destructive power?

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Paper for Summer Meeting.

POWER AND PERFORMANCE OF GASOLINE MOTOR TRUCKS

CORNELIUS T. MYERS*
(Member of the Society)

Eighteen months ago the writer presented to the Society a paper entitled "Motor Capacity for Motor Trucks," in which was given a formula for comparing the motor capacity (based on the A. L. A. M. rating) of the various motor trucks on the market. This formula was based on the characteristics of the truck—weight, motor dimensions and efficiency, gear-reduction, efficiency of the transmission system, and driving-wheel diameter. No attempt was made to go into the derivation of the formula, the object of the paper being to center attention on what seemed to the writer an unwarranted tendency on the part of designers of gasoline motor trucks to burden them with motors of too great capacity. Certain assumptions were made from the meager data then at hand, and comparisons were made with existing practice in motor truck design both in this country and abroad.

Shortly after the presentation of the paper mentioned, I was engaged on some work which put into practice the ideas referred to in the paper A truck was designed and built and a number of tests made with it. The results tallied so closely with previous assumptions that I am led to believe that those assumptions are nearly correct for the average conditions under which such trucks operate in this country. The results are therefore placed before you for discussion, and the derivation of the formula will be given so that there will be no chance for misunderstanding as to its scope or limitations.

To recall the gist of the previous paper, calculations were made to reduce motor dimensions, gear-reductions, etc., to the force available at the driving-wheels, the tractive effort which the motor and transmission system of the particular truck were capable of exerting. This force, expressed in pounds, was divided by the total weight in pounds on the tires (consisting of the chassis, body and load) and the result was the "Tractive Factor" of the truck, expressed in pounds of tractive effort per pound of total weight. This term designates the ability of the truck to overcome certain resistances to propulsion, and must at least be equal to a "Resistance Factor," composed of the road coefficient, plus an assumed grade which must be climbed in high gear, plus any other resistance to propulsion—such as air resistance or the load imposed by a trailer. The road coefficients were calculated from figures given by Mr. Churchward on page 22, Vol. I., S. A. E. Handbook, for resistance to rolling in pounds per ton on solid tires. These figures divided by 2000 become the road coefficients, and if we add the assumed grade (expressed in per cent. divided by 100) we have the resistance factor for any particular type of

*Mechanical Engineer, Detroit, Michigan.

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road on such a grade expressed in the same terms as the tractive factor. The two can then be equated for the purpose of checking or determining the motor capacity.

The formula was derived as follows:

Given the bore and stroke of a motor we can get the A. L. A. M. horsepower and determine the torque on the propeller-shaft.

$$\text{Torque of motor in lbs. at 1}'' \text{ radius} = \frac{33000 \times HP \times 12}{2\pi \times RPM} \qquad (1)$$

As the A. L. A. M. formula is based on the output at a piston speed of 1000 feet per minute, and s being the stroke of the motor in inches,

$$RPM = \frac{1000 \times 12}{2s} \qquad (2)$$

$$\text{A. L. A. M. HP} = \frac{b^2 n}{2.5} \qquad (3)$$

Substituting (2) and (3) in (1) we have

$$\text{torque} = t = \frac{33nb^2s}{2.5\pi} = 4.2nb^2s \qquad (4)$$

This motor torque can be reduced to tractive effort E at the periphery of the driving tires as follows:

$$E = \frac{t \times \text{gear-reduction } (R)}{\frac{1}{2} \text{ dia. of driving tires}} = \frac{2tR}{D} \qquad (5)$$

Substituting for t we have

$$E = \frac{8.4nb^2sR}{D} \text{ in pounds.} \qquad (6)$$

Now the tractive factor TF, referred to above, is the tractive effort in pounds divided by the total weight in pounds on the tires; equals $\frac{E}{W}$, whence,

$$TF = \frac{8.4nb^2sR}{D \times W} \qquad (7)$$

All of the above is on the assumption that the motor develops at any speed a torque equivalent to its A. L. A. M. horsepower rating at that speed, and that the efficiency factor of the transmission system is unity; so that for practical use, other than a comparison of the relative motor capacity of a number of trucks, it is necessary to multiply the result by

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e_m (the factor representing the actual motor torque with reference to the torque based on the A. L. A. M. rating), and by e_t (the factor representing the efficiency of the transmission system); e_m varying between .90 and 1.4, and e_t varying between .70 and .85. Then (7) becomes

$$\text{"TF"} = \frac{8.4nb^2sR}{D \times W} \times e_m \times e_t = \text{"RF"} \qquad (8)$$

And

$$nb^2s = \frac{\text{"RF"} \times D \times W}{8.4Re_me_t} \qquad (9)$$

In the previous paper e_m was taken as 1.2, and e_t as 0.70. Using these factors in connection with four-cylinder motors reduced (8) to

$$\text{"TF"} = \frac{28.22b^2sR}{D \times W} \qquad (10)$$

Several have taken the stand that $e_m = 1.2$ is too high and that at present the average truck motor cannot be relied upon to perform at such a rate. In the light of some experiments made during the past year, $e_m = 1.1$ might be taken as a more reasonable specification for the time being. On the other hand, e_t, even for chain-driven trucks which are not new, it is believed will be close to 0.80 in well designed chassis, and in some cases exceed this figure; however, 0.76 is quite conservative, and using these revised figures in connection with four-cylinder motors (8) becomes

$$\text{"TF"} = \frac{28.2b^2sR}{D \times W} = \text{"RF"} \qquad (11)$$

and

$$b^2s = \frac{\text{"RF"} \times D \times W}{28.2R} \qquad (12)$$

"TF" need not be greater than the resistance factor, *"RF,"* expressed in pounds of drawbar-pull per pound of total weight on the tires.

It may not be amiss here to repeat the road coefficients expressed in terms for use in these equations.

Hard, level asphalt	0.0100
Wood pavement	0.0115
Level macadam	0.0115 — 0.0300
Plank road	0.0090
Cobble stones	0.0175
Good dirt road	0.0110 — 0.0200
Ordinary country road (dirt)	0.0200
Sand	0.2000

The above figures are subject to some modification due to the variation in tire compounds, diameters, etc. The writer believes that under average

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conditions 0.0175 represents fairly well the coefficient of macadam and good dirt roads and the poorer stretches of city pavements. A truck, fully loaded, should be able to climb a 3 per cent. grade over such roads in gear, but much more than this is inadvisable because it burdens the truck with a powerplant and transmission out of proportion to the requirements for 80 to 90 per cent. of its work, except in cases of special service over normally bad roads and heavy grades. The sum of these two items, 0.0475, is the resistance factor, "*RF*." Where the body on the truck chassis is very large and the speed of the truck is comparatively high, an additional allowance must be made for wind resistance; but I believe that a "*TF*" greater than 0.0475 is hardly necessary for well-designed trucks of 1- to 7-ton load-capacity.

The truck referred to in the second paragraph of this paper was designed to carry a pay-load of 5000 pounds. The estimated weight of the chassis, body and load, was 10,000 pounds; the motor size was 3¾" x 5¼" (four cylinders); the gear-reduction on "high," 8.05 to 1; the diameter of the tires on the driving-wheels, 36". Applying these figures in (11) we have

$$\text{"}TF\text{"} = = \frac{28.2 \times 3\tfrac{3}{4} \times 3\tfrac{3}{4} \times 5\tfrac{1}{4} \times 8.05}{36 \times 10{,}000} = .0475$$

THE TRUCK TESTED

The truck was of conventional chain-drive type, built from parts largely purchased in the open market, but the general design was first carefully worked out, and every detail studied from four aspects—reliability, accessibility, efficiency and cost. The first two items were considered of prime importance, the third essential, and the last only when the first three were satisfied, although low cost was kept constantly in mind. Two general plans were made and discarded in favor of a third which seemed to be capable of fulfilling expectation on all four points. The mountings of the parts were planned with care that they should be simple as well as substantial; in fact, simplicity was the keynote of the chassis.

While the truck was built in accordance with some very definite theories, it was not built merely to demonstrate those theories, for the writer felt that previous experience fully warranted the lines followed. It was built as the first of a series to be placed on the market; and the trials were made in order to amply satisfy those interested that it would perform in accordance with certain standards and could be built within the range of a certain schedule of costs. The chassis was not a special one built to fit a theory instead of being laid down as a commercial proposition. It was put through a 1500-mile test in which it performed up to expectations. Some of the results of this test bear directly on the formulas given above.

The truck weighed 4800 pounds, including body, oil, water, gasoline, tool-kit, and a few spare parts. The pay-load carried throughout the

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greater part of the 1500 miles was 5600 pounds, which brought the weight on the tires up to 10,400 pounds. No attempt was made before starting to tune up the motor or other parts to their very best. These were assembled after an inspection and very few adjustments were made. A few accelerometer readings were taken to check the carbureter adjustment, and to ascertain in a general way whether the motor was developing its A.L.A.M. rated horsepower. As approximately rated-horsepower was indicated, nothing further was done; after a preliminary run of 50 miles under load, the truck was started across country.

The first run of 340.1 miles from Detroit to Pittsburgh was made in 3½ days. On this run one rear wheel twice went into the ditch; and in Cleveland one rear wheel went through a garage wooden floor. On all three occasions the truck pulled out under its own power without other assistance, in spite of extreme frame distortion. In Cleveland all the load was removed and a block-and-tackle rigged from a beam overhead hooked to the felloe of the wheel that had sunk through the floor. As the truck moved forward under the power delivered through the other wheel, the depressed wheel was raised. On the other two occasions only half the load was removed. Although on each occasion the frame was very badly distorted none of the working parts was cramped, practically the full power of the motor being available as tractive effort under the emergency conditions. Unless a motor truck is so designed that this can be accomplished, a larger "*TF*" must be assumed and a proportionately larger motor installed.

The total amount of gasoline consumed on the first trip was 34.75 gallons—equivalent to 9.79 miles per gallon. The specifications called for a performance of a 9 mi./gal. on hard level roads. The economy obtained was very satisfactory considering the many miles covered in low and intermediate gears. The amount of fuel given includes that used in starting up, doing a little cleaning, and waste of all kinds. Runs of 20 to 30 miles in and around Pittsburgh showed fuel economies well above 10 mi./gal.: equivalent to more than 25 pay ton-miles per gallon. The gross ton-miles per gallon in some instances exceeded 60.

Different makes of carbureter were carefully tested for comparison While there was a very appreciable variation in the economy the differences (for the most part) were not as great as expected. The acceleration readings, however, with the various carbureters, differed considerably —some being nearly double others.

The oil used in the motor amounted to 1.5 gallons; equivalent to 266.7 mi./gal. The specifications called for 250 mi./gal. The performance was fair but not up to expectation. It was considerably bettered, however, in later runs when more care was taken to prevent losses.

Much time was spent in taking accelerometer readings, measuring grades, and getting fuel consumptions under varying conditions. A specially calibrated speedometer with a 30-mile scale, instead of the usual 60-mile scale made possible accurate checking of the speed of the truck: and two odometers checked the mileage. Some of the data collected

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afford interesting light on the formula for "*TF*." Calculating this for 10,400 pounds we get

$$\text{"}TF\text{"} = \frac{28.2 \times 3\tfrac{3}{4} \times 3\tfrac{3}{4} \times 5\tfrac{1}{4} \times 8.05}{36 \times 10{,}400} = .0457$$

Subtract the road coefficient of .01 for new smooth brick-pavement and we have .0357, which indicates that the truck will climb a 3.57 per cent. grade on high gear on this pavement. As a matter of fact it repeatedly climbed grades of 4 to 4½ per cent., indicating that either e_m was greater than 1.1 or that e_t exceeded 76 per cent. Accelerometer readings gave a coasting-resistance of 35 pounds per ton, which is equivalent to a resistance factor of .0175; and the average acceleration reading at 12 m.p.h. was 1.325 ft./sec./sec., which is equivalent to .0415. As .0175 was allowed for the road coefficient alone (in the paragraph following the tabulation of the various road coefficients), it follows from these readings also that e_m and e_t are greater than have been allowed for in (11).

Assuming $e_m = 1.1$, $e_t = 100$ per cent., and a driving-wheel diameter of 34"—the last because the distance from the center-line of the axle to the ground was actually about 17", due to the flattening of the tires under the effect of the load carried—we get "*TF*" = .0622. Adding to the acceleration reading .0412 the road coefficient .010 and dividing the sum by "*TF*." we get $\frac{.0412 + .010}{.0622} = 82.3$ per cent. for the efficiency of the transmission system under full motor torque, on high gear, at 12 miles per hour. Calculating, by means of the accelerometer readings, the horsepower being delivered by the motor, we have

$(.0412 + .0175) \times 10{,}400 = 529$ pounds Tractive Effort, and

$$\frac{529 \times 17.6}{550 \times .83} = 20.5 \text{ horsepower,}$$

which tallies closely with the rated-horsepower at 955 r.p.m., plus the 10 per cent. given by the factor $e_m = 1.1$. Thus

$$\frac{3\tfrac{3}{4} \times 3\tfrac{3}{4} \times 4}{2.5} \times \frac{955}{1140} \times 1.1 = 20.6 \text{ HP.}$$

Comparing the accelerometer reading .0175 with the "TF" .0622, we find that the motor under normal road conditions is running at about 28 per cent. of its full capacity, and has a reserve of 2½ times the normal running power. While this proportion of power rating is not great enough to give the maximum gasoline mileage, it does very well for average conditions and leaves an ample margin of power for poor roads and moderate

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grades without the necessity of having to change gears. The "*TF*" for low gear figures

$$.0622 \times 3.65 \times .90 = .205$$

and deducting .0175 for the road coefficient we get a remainder of .1875 available for grade climbing on a country road—the equivalent of an 18¾ per cent. grade. The maximum measured grade encountered on the above-mentioned trip was 19.4 per cent., the road surface being of small round stones on a clay bed. The truck climbed it without hesitating.

A long series of carbureter tests, made subsequently, brought out further points of an interesting nature, but the writer has not analyzed the results thoroughly with respect to the subject at hand. As a check on carbureter design and adjustment I believe that the accelerometer, properly used, will yield a great deal of information. I have little faith in the results of block tests, for they do not impose operating conditions upon the apparatus tested. The criterion by which the product of our shops is judged is its performance *on the road*, and until we take pains to investigate this performance we are likely to go considerably astray.

As mentioned in the previous paper, the "*TF*" formula affords a ready means of comparing the "power" of gasoline motor vehicles. This is a subject which has suffered much in the hands of many associated with the motor industry, and possibly the formula will be the medium of dispelling some rather dubious arguments as to the value of large motors in gasoline motor vehicles of any kind. The formula as indicated in (8) is comprehensive, and unless every factor embraced in it is considered, there can be no just comparison of one chassis with another so far as its power-plant is concerned. As shown in (10) it affords a ready gage for the average truck at present.

For pleasure cars the constants must be modified for use in designing, and an additional coefficient for wind resistance added to the resistance factor "*RF*."

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Paper for Summer Meeting.

HIGHEST QUALITY SIX-CYLINDER CHASSIS FOR AMERICA

By A. Ludlow Clayden,* M. I. A. E.

(Member of the Society.)

At the present time the position of the six-cylinder car in Europe forms a very interesting study. It is doubtful whether anyone can forecast its future. In the days when high power was obtainable only from large car by means of using six cylinders. At the present time methods of large car by means of using six cylinders. At the present time methods of manufacture and principles of design have undergone so much alteration that numerous high-powered four-cylinder cars, which are quite as smooth and pleasant to handle as the best six-cylinders, are coming on the market. Further, there are a number of difficulties peculiar to the six-cylinder construction. The vexed question of six-cylinder carburetion has never been settled. The difficulty of eliminating periodic vibrations with the necessarily long crankshaft still remains pronounced. Also, probably owing to piston friction principally, the six-cylinder engine is invariably less efficient than a four-cylinder of equally good construction—efficient, that is to say, in the power to volume ratio. This means that for a given power a six-cylinder car must necessarily be considerably heavier than a four cylinder. Add to this increased cost for a given power, decrease of available body space for a given wheelbase, or greater length and therefore cumbersomeness necessary to carry a bigger body, and most of the disadvantages of the six-cylinder car have been summed up. On the other hand, there are a few six-cylinder cars which possess greater smoothness than has yet been attained with any four-cylinder, owing to the undeniably better torque, but none of these cars is efficient. They are cars which, while suited excellently to bear elaborate carriage work and provide luxurious travel at moderately high rates of speed, are seldom found in the possession of men who drive themselves or take a great interest in the mechanism. From an advertising point of view the six-cylinder car appears to have been made the only possible thing for America. In Europe the six-cylinder argument is practically dead.

It is, however, possible that the present position of the six-cylinder car in Europe is misleading because no effort has been given to the production of a really efficient six-cylinder, except by the Sunbeam company; the 30-hp. Sunbeam holds records which leave no doubt whatever concerning its efficiency. The method followed by such concerns as the Sunbeam company is, first, to produce highly efficient cars and then obtain quietness, etc., without depreciating the efficiency. In this the Sunbeam

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and Vauxhall companies in particular have been remarkably successful. The Sunbeam is, of course, a small six-cylinder, but there seems to be no reason why the same methods should not be applied to a larger engine.

SUMMARY OF COMMENTS

In making a new car for England or the Continent it would undoubtedly be far better to specialize on a highly efficient four-cylinder type and leave the six-cylinder entirely alone. On the other hand, it seems that for a new American car the so far untried scheme is the production of a highly efficient six-cylinder. The specification hereunder is a suggestion for the main characteristics of such a chassis.

SPECIFICATION FOR MOTOR

The dimensions should be certainly not more than 4" bore by 6" stroke and there would be several advantages in adopting 3½" bore by 5½" stroke; this latter size would be capable of giving as much power as the largest American six-cylinder engines if the engine were made in accordance with European principles. The advantages of the smaller dimensions would be less weight, lower cost, greater ease in eliminating vibration and less overall length.

The cylinders should be cast in threes with the valves all on the right-hand side. The three-cylinder blocks are quite handleable by one man; can be rigged in position quickly and easily; are not so likely to be bad castings owing to having less complication than a block of six; need not actually require more machining if care be taken in the design; and, finally, are much easier to remove and replace. When four-cylinder blocks were first introduced there was much complaint in certain quarters that private owners would find them very awkward to take off, and undoubtedly there was something in the objection. A six-cylinder block needs very elaborate tackle and several men to remove it from and replace it on the crankcase for cleaning with the pistons in position. Of course, this is not an objection that the ordinary buyer thinks very much of until he has to take the engine down, but when he does he never forgets it. Also, in my opinion, a six-cylinder block looks very heavy and rather clumsy. However, this last is not a point of great importance.

The water-jacketing should be sufficiently generous to enable thermo-syphon cooling to be satisfactory with an atmospheric temperature of 80° F. in ordinary country. In the cylinder blocks the passages to the intake should be cored and carried through the water-jacket to the opposite side to the valves, bringing the carbureter on the left-hand side. Between the carbureter and the cylinder castings the shortest possible pipe should be used and this also should be jacketed in a manner ensuring ample circulation of hot water. Although the word "pipe" has been used it is better to employ a box big enough to contain one or more cylinder charges, or else to use a circular loop pipe, as has been illustrated frequently on various racing engines, and as is used by the Austin company notably. It will probably be necessary to experiment with different inlet-pipe arrangements, as different engines do not appear to be suited by precisely the same design.

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Returning to the cylinder castings, these would each have a water inlet at the bottom on the same side as the carbureter. There would be the usual cast dome for a head, and in addition the Napier practice should be followed of taking two pipes from the jacket immediately adjacent to the valve-pockets, joining these and leading them up to the radiator separately from the main outlet. This has been found to make a very great difference in engines used in mountainous districts, as it prevents entirely the otherwise always-present danger of formation of small pockets of steam in corners of the valve-jackets, it being almost impossible to cast cylinders without risk of a few traps of this nature.

The crankshaft should have seven bearings because, although it is possible to make a fairly satisfactory engine with a smaller number, the best possible running cannot be obtained unless the supports for the shaft possess the maximum of rigidity and this can only be the case with seven bearings. The diameter should be not less than 2½ inches, this applying to both the main journals and the crankpins, while the webs should be proportionally stiff. Weight should not be spared in the crankcase, as the success, or non-success, of the six-cylinder engine depends almost entirely on the absolute rigidity of this portion. Very stiff webbing to support all the bearings is therefore recommended, and the case itself should be distinctly on the thick side. Distribution gearing should be by inverted-tooth chain. A chain 3 inches wide is recommended; 2½ inches might be regarded as the minimum. There are various methods of adjustment, and adjustment is deemed to be essential, not for the use of the owner of the car, but for convenience in manufacture. There would be, of course, a crankshaft pinion, the camshaft wheel, and at least one other. Whether this should drive the water pump and magneto direct or whether the third pinion should be made in one piece with a skew gear driving a cross-shaft for these two accessories, would depend upon the general layout decided upon. If it is possible to dispense with the cross-shaft a certain amount of manufacturing cost is, of course, avoided. On the other hand, usually with large engines the magneto and the pump are brought into the most satisfactory and most accessible position by the use of a cross-shaft, more especially when it is necessary to keep the magneto high. The pump might also be inserted directly in the cylinder casting by leaving the front end of the cylinder open and bolting on a bronze or aluminium casting carrying the pump and fan. This would add a facing operation, but I believe it would save in the long run, as the machining of the pump chamber and the bearings for the fan can be carried out far more expeditiously on a small piece than on the whole cylinder block.

The exhaust branch should be a separate casting provided with one expansion joint between the two cylinder-blocks, and it should be kept high, so as to interfere in no way with the accessibility of the valves. Many European makers have made experimental designs in which the exhaust manifold was part of the casting. They have, however, always returned to the separate branch, which I think may be taken as sufficient evidence that the cast-in branch is not satisfactory. Supposing it is water-cooled,

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it is necessary to make it very big externally and also to increase considerably the amount of water carried. If, on the other hand, it is not water-cooled, it becomes much hotter than any other part of the casting; being hotter it is bound to expand and by expanding it cannot help distorting the cylinders. Even though this distortion be slight it is sufficient to increase piston friction and eventually bring about uneven cylinder-wear. Further, in order to make the engine thoroughly efficient (and in my view an engine which is not thoroughly efficient is not worth introducing as a newcomer on an already well-stocked market), it is essential that the inside of both the exhaust and inlet pipes be as smooth as possible, as the resistance offered by roughness of surface is a great deal more than would ordinarily be expected. Owing to the rather complicated nature of the core it is impossible to get anything like a smooth interior with a one-piece cylinder and exhaust branch. Of course, foundry practice has improved enormously, but I am inclined to believe that there is a tendency to put too much on the foundry. Thus, in a six-cylinder block, owing to the large amount of metal to be poured, and the considerable contraction, it is possible for quite grave inaccuracies in wall thickness to occur which cannot be checked except by cutting up a casting and, of course, bad castings are sure to be those which one does not cut up.

The valves will, of course, be enclosed under the usual cover-plates, but the tappets should be mounted in the cylinder foot. The tappets ought, in fact, to be situated in a shallow trough formed in the casting; that is to say, with the cover-plate removed there should be still left a sufficiently deep chamber around the tappets to contain oil which is bound to be exuded from the tappets. Tappets can be made without rollers, but to the detriment of cam durability, and to a certain extent to the detriment of silence. I do not quite see why this should be so, but undoubtedly it is true that the roller helps to keep down noise. It is advantageous to work the tappets in the nearest possible approach to an oil bath, and the arrangement suggested, although not easy to describe in words, is very simple on paper. The ends of the cover-plates should be curved, instead of using a flat plate butting against the end-pieces made with the cylinder casting, because these solid end-pieces render the valves at each end of a cylinder block extremely inaccessible. The curving adds a little to the cost but is certainly worthy.

The camshaft should be of a diameter corresponding proportionally to that of the crankshaft, and cams of the largest possible diameter which can be accommodated should be employed, partly for the sake of durability, but more for the sake of getting the desired valve diagram as nearly as possible. Valves should be not less than 2⅛ inches diameter.

For lubricating arrangements the crankshaft should be drilled and oil supplied to each main bearing at about 30 pounds per square inch pressure. The oil would pass through the shaft to the big ends and no special means need be taken for lubricating the piston-pins or the cylinders. To prevent the access of too much oil to the cylinders the crankcase should be made with a false top. Immediately beneath each cylinder the only

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connection with the crankcase should consist of the narrowest slot through which it is possible to insert the connecting-rod, but the baffle-plates should not close the bottom of each cylinder individually. A method which has been employed very successfully is to extend the crankcase upwards above the baffles, which are cast in one piece with it, so that the cylinders stand open to a shallow chamber—say one inch deep—running the whole length of the crankcase and separated from the crankshaft by the thin web with the necessary six connecting-rod slats. This longitudinal chamber allows the air displaced by the descending pistons to travel along and ascend under the other three without passage through the oil-laden atmosphere of the crankcase proper. It has been found that ample lubrication is obtained when using high-pressure oil-feed, and with this scheme smoking troubles are overcome. In order to complete discussion of the system of lubrication it is necessary to anticipate a little, as one detail of the lay-out to be recommended affects this point profoundly.

FLYWHEEL IN FRONT OF ENGINE

The suggested design includes a recommendation that the flywheel be placed at the front end of the motor instead of at the rear, as usual. The three lowest points in a chassis are the front axle, rear axle and flywheel, and it is easy to see that if there is a hump in the road of wave formation it will be easy for the hump to clear both the front and rear axles and yet strike the flywheel, owing to both axles being lower than normal just at the instant that the flywheel is over the hump. With the flywheel at the front end it would be protected by the front axle and over anything which the front axle would pass the flywheel would be carried also. Another conspicuous advantage, though not so important as the one just mentioned, is that consequent upon the fact that with a unit system for the engine and gear-box the necessary enlargement of the casing around the flywheel is a source of considerable weakness, or, looked at from the other point of view, the necessary enlargement calls for a very great increase of weight in order to get sufficient strength. A smaller casting without the flywheel pit is cheaper in first cost and easier to machine. The arrangement also has several advantages when the fitting of an electric motor-starter has to be considered, but these need not be gone into in detail at the moment.

Returning, therefore, to the lubrication system, the deep end of the crankcase sump obviously ought to be at the forward end as close as possible to the flywheel; otherwise the principal advantage of placing the latter at the front end is nullified. There is, however, a difficulty in that the oil supply to the pump needs to be most certain while ascending a grade. It is possible that this difficulty is not so serious as it appears, but to decide it definitely without knowing the actual clearances and without setting out the design on paper with some degree of accuracy, is almost impossible. Assuming that there is difficulty, the best way of avoiding it would probably be to adopt the system employed on the six-cylinder Wolseley cars. Here there is practically no sump, the crankcase being quite shallow, sloping downwards slightly from each end to the center. Oil is withdrawn from the crankcase by a gear-pump and supplied to a box which

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takes the place of the sump and is in one piece with the crankcase and high up on the side. This suction pump is of large dimensions but of quite ordinary design and appears to be in every way satisfactory. From this box on the side of the crankcase—which is large enough to contain all the oil in circulation—the forced feeds to the bearings are supplied by a separate and smaller pump. Failure of the suction pump would result in the flooding of the crankcase which would be announced by smoke, and failure of the supply pump would, of course, be shown by the indicator on the dashboard. The extra pump, however, introduces no extra risk and merely adds a little to the cost. The operation of emptying the system, washing out the oil box and so on, is facilitated a little by the higher placing, and the filters likewise become more accessible. For the suction pump a gear pattern is probably the best, but it has a disadvantage for forced feeding in that the output is not easy to control, appearing to bear no very direct relation to the speed. For the Vauxhall cars, including the racing machines, piston pumps have always been used for the oil, and it is doubtful whether this type of pump can possibly be improved upon for any purpose. It is not expensive to make and is easy to set to give the desired feed.

Having discussed the lubrication system it is perhaps worth while to add a word concerning the bearings, which should be of babbitt metal and might be die-cast. One point, however, is essential and that is that the crankshaft should be fitted to these bearings by thoroughly efficient hand-scraping. For six-cylinder work the reamering system *could* be made to serve, but it is not possible to obtain really first-class results from it.

As to the pistons, these would preferably be of cast iron with the pins oscillating in the small ends of the connecting-rods, for which latter there is nothing practically better than a good drop forging. Phosphor-bronze bushes on the hardest possible steel piston-pins give the most satisfactory results. For the other bearings the exact nature of the white metal employed would of necessity depend upon the nature of the steel used for the crankshaft. For a six-cylinder crank it is probably worth while to machine all the webs, especially in a seven-bearing crank whereof the clearances must of necessity be somewhat small. It is not, however, necessary that the finish on the webs be of a very high order, because it is regarded as essential that the crank shall be balanced on a running balance machine, and this naturally applies to the flywheel as well.

CLUTCH AND GEAR-BOX

Having the flywheel at the front end of the motor makes possible a single casting or a single pair of castings (the top half and bottom half) for the crankcase and gear-box. It would, however, probably be more convenient to make a separate piece of the gear-box and the clutch-box. This could be decided definitely only after laying out the design on paper. A lengthy experience of clutches of every kind has led to the conclusion that the dry-plate clutch, in which one surface is steel and the other woven wire and asbestos compound, is the most satisfactory for cars of high power. The number of plates depends upon the diameter and the

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engine power, and can be decided only by experience. For mounting the clutch there would be an extension of the crankshaft and the shaft carrying the striking gear would preferably be placed beneath the center rather than above it. Such positioning enables long pedals to be used, giving big leverage, while it also clears the clutch completely from above and makes adjustments readily accessible.

It is assumed that the gear-box and crankcase would be bored after being bolted together, and therefore the main gearshaft ought to be perfectly in line with the clutchshaft. It is, however, recommended that a simple universal coupling, preferably of the spring-steel-ring or Schneider type, be employed as this is very easy to disconnect without taking down either part of the unit, and also reduces the accuracy in boring necessary by a small fraction of an inch. Naturally the clutch would be enclosed completely; the lid or cover giving access to it may be either an aluminium casting or a steel pressing.

Turning now to the gear-box, four speeds with a reverse should, of course, be provided. Wheels with big teeth are preferred. Considerable width of tooth is also an advantage from the point of view of silence. The spigot should run on ball bearings, but the main shaft and layshaft may be mounted on either ball or taper roller bearings. The advantage of using the latter is that it eliminates the otherwise absolutely essential thrust race on the mainshaft. Concerning the arrangement of the gears, and the striking mechanism inside the box, no departures from the normal practice are considered, but the control should undoubtedly be in the center of the chassis, the gate thus coming immediately on top of the gear-box. Probably the best arrangement for the gear-shifting lever is to mount it on a ball which is automatically dirt-proof and self-lubricated. There are, however, disadvantages in not having a visible gate, but there is a design entirely adaptable for such a layout as the one under consideration.

FINAL DRIVE

It is not proposed to discuss axle arrangements at the present time, but it is believed that the best arrangement, considering the advantages and disadvantages of all systems, is to have a single universal joint behind the gear-box, contained inside a large ball, the latter forming the end of a substantial tube containing the propeller-shaft. This tube acts as the driving member, as a radius- and as a torque-rod. The arrangement can perhaps be improved by the addition of side rods, but they are in themselves troublesome in certain respects and it is doubtful whether the sum total of gain in having them amounts to anything at all. The possibility of side-sway from lack of rigidity can be overcome by the use of wide springs with well-proportioned eyes and carefully fitted shackle bolts. One essential of the arrangement suggested is that the ball be of thoroughly adequate diameter; somewhere in the neighborhood of 5 inches is suggested as about right for a car of the size under consideration. The universal joint contained therein would preferably be of the ring type with ball bearings, or again, taper roller bearings, as these types appear to be

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everlasting. The torque-tube would, of course, be steel; the ball should be phosphor-bronze.

It now remains to consider the way in which the thrust from the ball should be applied to the car as a whole. It is suggested that the end of the gear-box be cast steel and that the ball housing be machined in this. Near the forward end of the power unit on the sides of the crankcase would be a pair of substantial pads, placed vertically, to which a pair of drop forged arms could be attached. It would be possible to use the ordinary cast aluminium arms, but it is deemed preferable to take the drive through steel. The ends of these drop-forged arms would be turned spherical, giving balls about 2 inches in diameter, and a similar ball would be bolted firmly on the gear-box by a pair of long bolts passing right across the steel casting on either side of the large ball at the rear end. The necessary sockets would be placed on the side members to the frame for the front ends, and on a cross member for the back end. This arrangement would avoid the necessity of any dropped or bent cross members, thereby avoiding weakness and expense; would relieve the unit from all twisting stresses and provide ample area for driving. It might be an advantage to mount the socket for the ball at the rear end, itself on a swivel, so that the whole of the driving force would be applied through the two arms; this would dispense with the possibility of undue load being placed on any one ball through disalignment of the frame. Conversely, it might be preferable to take all the drive through the single suspension on the cross member at the rear and allow the front sockets a little swing. Probably convenience in manufacture and erection would be the deciding factor. One detail which has not been mentioned is that the universal joint should be allowed a little telescopic movement on splines, on either the propeller-shaft or the gear shaft. This would compensate for any inaccuracies in erection and also make it possible to withdraw the whole transmission by removing the back half of the cast steel sphere-casing. It might be pointed out that this latter provides a unit which can be fitted in the frame very easily, and which is entirely independent of any necessity for lining up to the rear axle. The system described is likewise a complete unit and the only great accuracy required in the spring mounting on the frame is to see that the two axles are parallel.

The steering-gear would be bolted to the crankcase on the left-hand side of the engine, as left-hand drive is undeniably the only possibility for American usage. This would leave the right-hand side of the engine very clear for obtaining access to the motor starter and the oil tank, if the Wolseley arrangement were adopted. It is suggested that if a cross-shaft is used the magneto should be so placed that its contact portion is accessible from the left-hand side. It is an advantage to have such parts as carbureter, magneto and lubrication details so placed that they can be all inspected at the same time with the minimum amount of moving about.

Engine control should consist of hand-throttle and spark lever on the steering-wheel, and also a well-balanced foot-throttle, so operating

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that the hand-lever controls the cut-off. The throttle-pedal should be situated immediately behind the base of the steering-column and between the brake- and clutch-pedals. An arrangement of steering-gear which allows for a slight adjustment for rake is also recommended, not to enable different angles to be obtained for different styles of body-work, but to allow the driver a little latitude as to the closeness of the wheel. This is a point which has been neglected very much indeed, but there is no doubt that a large man is far better suited by a wheel rather higher up and rather further forward than a small man. All that is needed is an arc of travel giving about 3 inches of movement measured at the top end of the steering-column.

For the motor-starter it will be possible to fit an electric dynamotor either at the forward end of the crankcase on the right-hand side to mesh with the flywheel, or—and this would probably be much neater—on the right-hand side below the valve level and at the back end, taking the normal drive in the most convenient way, preferably by chain from the camshaft and using a small sliding gear or a little epicyclic train to provide a gear-down for starting. Yet another place where the dynamo can be fitted is on the side of the clutch-case, the outside of the clutch being toothed.

CARBURETER

The carbureter is outside the scope of the present discussion. Just as with inlet-pipe arrangements, the best carbureter for any engine is usually found by a process of trial and error. Theoretically the best is the Polyrhoe or the Claudel, but the former is very difficult to manufacture and both are expensive, while in many cases other carbureters theoretically less pleasant seem to give better results.

WATER PUMP

The only other detail of which no particular mention has been made is the water pump, the only requisite for which is that it should be sufficiently powerful to cope with any climatic conditions likely to be encountered. It should be of a centrifugal pattern which allows fairly free syphonic circulation, if the drive fails; it should have an easily adjustable gland, and a weak coupling between it and its driving-shaft, which will fracture readily should an attempt be made to start the engine with the pump frozen.

FUEL FEED

The method of fuel feeding probably most satisfactory is to force fuel by air pressure from a large tank through a small tank on the dash-board to the carbureter. This small tank will trap sufficient fluid to enable a start to be obtained and to give a few minutes' running without the necessity of pumping up the pressure-system by hand. To supply the pressure there should be a plunger air-pump, the clearances being calculated so that is is never possible to deliver air at more than about five or six pounds per square inch. This pump might be driven direct from the camshaft or incorporated with one of the oil pumps. I can quite understand that in America there is a liability for pressure joints to

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work loose, but even if a gravity dash-tank were used, I would prefer to maintain the feed by pressure, and in such case the pipes would be so short that I think vibration troubles need not be feared. One cannot obtain efficiency with a long inlet-pipe and it is impossible to avoid the use of a long inlet-pipe with a gravity-feed because the tank cannot be mounted at a sufficient altitude, even on the dash, if it is to hold enough gasoline for 200 miles. It would, however, be possible to devise a dash-board tank with two compartments and to use the pressure merely to lift fuel from the bottom compartment to the upper one.

BRAKE WORK

The contracting-band type of brake ought not to be considered. It has only one advantage, which is that it is easy to make very cheaply. A band-brake is never powerful, never quick in action, never easy to adjust, invariably gives rise to rattle (as it contains of necessity a large number of joints which get lubricated principally with mud) and moreover is extremely unsightly. Granting that extremely good working surfaces for brakes are steel and woven material such as has been recommended for the clutch, the best arrangement from all points of view seems to consist of wide cast steel drums, ribbed for cooling, fitted to each rear wheel, and two sets of shoes side by side each faced with lining material, one pair operated by the hand-lever and the other pair by the right-hand pedal. Such brakes can be enclosed completely so as to be protected from dirt. There are not many bearings or joints and all these are easy to supply with adequate lubricators.

The best operating system is to run the two pull-rods slightly above the torque tube, actuating the expanding cams of the outer pair of brakes by means of shafts, taking one bearing in the brake bracket at each end and the other bearing in the differential case; the other pair of brakes being controlled from tubes rotating on the outside of the said shafts. These are best situated above the axle and are neater and less troublesome to erect than cross-shafts on the frame itself. The ends of the operating arms would, of course, be connected by an ordinary compensating link. For adjustment and setting, hand-tensioning wing-nuts would be applied to the pull-rods and there should be some arrangement whereby the operating arms can be set relatively to the spreading cams, so that as wear takes place the levers can still be kept in a normally vertical position. It would be easily possible to arrange for the lubrication of the bearings of the brake-operating shafts at the inner ends, from the inside of the differential box. The bearings at the outer ends can be supplied with grease from the same cup that feeds the bearing between the spring table and the axle sleeve. Thus the whole of the connections should be lubricated by means of a single pair of greasers on the axle.

STEERING-GEAR AND CONTROL PARTS

There is no doubt that ultimately all front axles will be designed with the steering swivel-pin inside the hub and in the plane of the wheel, because this arrangement removes all possibility of shock in the

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steering-wheel, gives absolute security on the roughest roads and enhances the durability of the steering-gear enormously. The only disadvantage is the necessarily large hub which has been considered rather ugly. If such a matter is deemed important, care should be taken that ample ball thrust-bearings are provided in the swivel-pins and in the steering-gear itself. There is only one pattern of ball-joint for steering connections which is absolutely secure and this should, of course, be ample. For the control through the steering-column the simplest possible arrangement should be employed, as a great many controls which are used at the present time contain a very large number of totally unnecessary moving parts.

Note for Summer Meeting.

TENDENCY IN EUROPEAN CAR CONSTRUCTION

By Robert W. A. Brewer.*

(Member of the Society.)

The following brief notes will convey an idea of the modern European tendency with regard to the demand of the public and will give what is possibly an advanced forecast of the most saleable type:

BODY

Cleanness of design is only obtained satisfactorily by the elimination of flat surfaces presented either to the direction of motion or at the rear of the body. Streamline contour is carried out in a more complete manner than it is understood in the States, for greater attention is paid to the rear part of the body as well as to the shape of the fenders. Seating capacity for four persons in a body width of about 44", the backs of the seats reasonably high, i. e., the seat cushions resting on the floor-boards. The cowl so shaped as to merge with the wind-screen set at an angle of about 45°. This deflects the air current above the heads of the occupants without impressing too great a wind resistance. The total head resistance, plus rolling resistance of such a body on a good smooth road at about 60 miles per hour, would be about 25 h.p., and the motor should therefore develop about 36 h.p. on brake test at say 2000 r.p.m.

MOTOR

Four-cylinder high-efficiency motors are far more popular than any other type. The six-cylinder has only a comparatively small field of adherents, and these of the wealthier class. Anything between 80 m.m. and 90 m.m. bore, or even 95 m.m., will cover the requirements. The ultra

*Consulting Engineer, London.

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long stroke is disappearing. A good size would be 85 x 140 and should easily develop the necessary power.

GEARS

Four forward speeds are necessary, direct on top. The gear ratio in the rear axle 3½ or 4 to 1. This enables a very large range on top speed drive. The high rotational engine speed will provide the high car speed so long as the torque curve does not reach its peak.

CONTROL

Right-hand driving is universal with the gear levers in an enclosed gate. Throttle control by foot pedal with over-riding hand-operated mechanism by small lever on the steering-column.

SPRINGS

Semi-elliptic all round, with a tendency to the cantilever.

ACCESSIBILITY

A modern motor being so reliable, accessibility is scarcely required. except to the carbureter and magneto. The former is preferably fed from a fuel tank contained in the cowl, gravity supply to the carbureter itself which is placed as high up as possible and often directly bolted to the engine casting. Personally I prefer a special form of combined inlet and exhaust manifold, which gives a streamline flow, as with this manifold considerable fuel economy can be effected.

EFFICIENCY

It should be quite possible to get a brake mean effective pressure of 80 to 100 pounds per square inch from a modern engine. The compression ratio can be about 4.7 to 1, but this depends on the contour of the combustion head. Such a motor should have no vibration, and when properly designed and made, runs equally smoothly at all speeds up to 2500 r.p.m. Pressure-fed lubrication to all the crankshaft bearings is essential. If the clearances are suitably made, there should be no signs of metallic contact on the big-end bearings. This can be carried out quite easily in practice. Lightness of reciprocating parts is essential.

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Paper for Summer Meeting.

THE IDEAL AUTOMOBILE

SCIENTIFICALLY CORRECT DISTRIBUTION OF MATERIAL

By Alanson P. Brush*

(Member of the Society)

I am glad of the opportunity to use this title for a paper before a general meeting of our members. Probably there is no designer present who has not, at some time in his experience, been asked to design an absolutely ideal automobile and probably has been helped (?) by being given a mass of ideal (?) automobile specifications, that have been very kindly (?) secured for him by the sales organization.

The ideal automobile is a ghost that we ought to lay; it has haunted most of us long enough.

Ideal for what purpose? The carrying of one, two, three, four, five, six, seven, or more passengers? Ideal from whose standpoint? The foundryman, the drop forge man, the painter, the factory superintendent, the user, or any other of the hundred and one personalities interested in each and every automobile produced?

There is not, and never can be, an ideal automobile, but what there can and should be, is more progress toward the ideal in the motor car industry. I think that if we are to discuss ideals at all, we must recognize the word "ideal" as an expression of infinity and therefore capable only of indicating direction of progress with no possibility of final attainment. To get down into less rarified atmosphere and a little of the dust of commercialism in our lungs, where we can talk in finite terms of accomplishment, progress toward the ideal in the motor car industry, as I think you will agree, must be progress in the making of the automobile increasingly useful to the human race. If this be true then the greatest advance toward the ideal in any automobile, for whatever class of buyer, and of whatever size, is that automobile which will give to its ultimate user *the greatest amount of satisfaction per dollar of total cost.*

I want you to keep in mind that I am using the words "satisfaction" and "cost" in their broadest possible application. For example, the most durable and lowest cost car, for its size and type, might be unsatisfactory if of bizarre and displeasing appearance. Now this makes it obvious that "satisfaction" used in this sense, is not only a broad generalization but a somewhat elusive one. The question will naturally suggest itself to you—how far can we be specific in the discussion of such a term, which involves as one of its component parts so unstable a thing as the average man's taste?

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We have all been told by the omniscient selling organization that the general public, or at least that portion of it which buys automobiles, is as fickle in its ideas of beauty and harmony of proportion, as a woman is in regard to the amount of cloth necessary to make a skirt. Personally, I do not believe that we, as a body who are supposed to deal in pure logic, have been as consistent in our work as has been the automobile buying public in the matter of general appearance in a motor car. The members of this Society can remember with me when in appearance the then standard automobile bore a striking resemblance to a combination of toboggan, bicycle, and parlor settee, when pretty much everything about it was exposed, except the head of the piston and the inner end of the spark plug and even these parts had a way of occasionally making themselves visible, in an effort to lend piquancy to automobiling as a sport. At that time in the history of the automobile industry, even fenders were extras, to be purchased and shed along the way en tour.

Now if you will follow with your mind's eye the history of development in the appearance of the automobile, you will observe that the buying public has been singularly consistent in approving only those changes in appearance which have tended toward simplicity of form and comfort for the user. Can we, as exponents of pure logic (?), claim equal consistency in the development of those mechanical elements of the car which do not affect the appearance, and with regard to which the buying public is less dictatorial? There are four principal elements which determine the satisfaction or lack of satisfaction on the part of the user of any automobile. They are:

1—Design.
2—Material.
3—Workmanship.
4—Instruction of the user and caretaker.

All dissatisfaction must arise from faults in some one or some combination of these elements. I suppose this paper would be more conventional if it confined itself to the discussion of the first of these elements but I do not believe that any of them can be discussed broadly and intelligently, without the introduction of the other three. To illustrate this point I will call your attention to the introduction of electric starting and lighting. I think every one present will agree that the automobile buying public was singularly fortunate in that the introduction of this equipment was undertaken by two organizations that were well equipped to instruct the user and caretaker and that realized fully the importance of such instruction. Had the same equipment, with the same design, and with the same careful workmanship back of it, been introduced, with the lack of attention to such instruction of the user and caretaker, as is altogether too common, I believe there is little doubt that the public would have felt that it could not render a favorable verdict on such equipment, until it had had several years of further development.

I could go on indefinitely and cite examples where progress toward the ideal has been achieved because of the competence and enthusiasm

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of the producing and sales organizations, and where on the contrary, possible progress toward the ideal has not been achieved because of lack of intelligent co-operation on the part of the producing or selling organization. I will not, however, take more time on this phase of the question, as I believe every one present is perfectly agreed with me that while progress in design is desirable and necessary, its value to the industry is, to a large extent, dependent upon the intelligence and co-operation of the producing and selling organizations. It is my intent to call your attention to what seems to me those features of motor car design wherein there is most room for progress, but always provided that such progress in the design goes to the public backed by properly selected material, proper workmanship and proper instruction of the user and caretaker.

The virtues of a motor car, as discovered by the buyer, I believe, come in about this order:

1—Price.
2—Appearance.
3—Initial performance.
4—Ultimate performance.

I am using the expression "ultimate performance" as meaning the relative permanence of the car in all respects.

Right here I want to remind you that I am talking of progress toward the ideal as being those changes in motor car construction which, in the hands of proper organizations will make the automobile increasingly valuable to civilized humanity and that therefore there is no place in this paper for consideration of even desirable characteristics which are too expensive to be of commercial value, nor do I give any place to those changes with which we are all familiar which simply achieve ordinary results, at the usual cost and have only the questionable virtue of being different.

DISTRIBUTION OF MATERIAL

The most valuable changes are those which can give to the user superior results, at a reduction in cost. And chief among all progressive changes is, in my judgment, a more scientifically correct distribution of the material used in a motor car. Present-day conventional automobile design seems to me to be a really praiseworthy development in appearance and comfort to the user but a development unaccompanied by sufficient study of the way in which materials are used to secure such comfort and appearance. For example, bodies, fenders, running-boards, running-board aprons, running-board supports, are no inconsiderable part of the weight of the modern automobile and yet their function in the conventional structure is solely that of securing desired appearance and comfort to the user. They do not, in any way, add to the stability of the car structure; on the contrary, they lessen it. Here, in my judgment, is an exceedingly fertile field for the engineer. The first natural question with regard to these parts is—how can their weight be reduced, and, second, if we reduce their weight, will we not reduce their stability

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and produce a car that will in a comparatively short time become noisy, unsightly and unsatisfactory to its user? The third, and most promising viewpoint is—cannot some or all of these parts be made to perform their present functions of securing comfort and appearance and at the same time add to the stability of the car, by being so arranged as to carry the strains to which the structure is subjected in use?

I would place second in importance the consideration of the structure of the rear axle, because, while the amount of weight which can be saved here may not be very great, it is particularly valuable because it is necessarily unsprung, and therefore any weight reduction which does not introduce weakness or other objectionable characteristics, adds to tire mileage and to the riding qualities of the car. The materials used in rear axles must perform two functions:

1—To carry weight.

2—To propel the vehicle.

I suggest for your consideration a moment's thought as to how much of the weight of the conventional rear axle can be taken out of it and still leave the same load-carrying capacity, or in other words, how much of the weight of a conventional rear axle is devoted solely to the propelling function and whether a considerable portion of this material could not be made to assist in the load-carrying capacity of the axle, without detriment to its other duties, with a reduction in the total weight and cost of the structure and an actual increase in its serviceability.

We naturally come now to my third element in motor car construction, which I suppose many of you would place second or possibly first, namely, the motor. I know that I am placing myself with the minority when I do not admit that motor discussion can be summed up from beginning to end in small bore, long stroke, and high speed. As I see it basically, the opportunity for progress in motor design may be summed up as cost reduction per car-mile, without sacrifice of performance; and while an increase of motor speed may be one way of securing progress in this direction, it is not necessarily the only way or even the best way. Given the same weight per horsepower, other things being equal, a slower moving mechanism is bound to be more durable, and I believe that a more scientific distribution of the materials which go into the motor can result in a highly satisfactory weight and cost reduction, securing instead of extremely high speed, greater piston displacement per revolution of the engine, with consequent lower speed and less reduction between the motor and the rear wheels, with added stability in proportion to weight and cost.

I might go on indefinitely in discussion of the various elements of the motor car but this paper is already too long and I am not attempting a detailed treatise on all of the elements wherein I believe there is room for progress toward the ideal. In reviewing the ground, which I have already attempted to cover, I think I can epitomize the whole situation best by expressing a profound conviction that there is room throughout the whole automobile to make a more scientific use and

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distribution of the materials commercially available, with a resultant decrease in weight and cost and a resultant increase in initial and ultimate performance, without any sacrifice and probably with some advance in appearance and comfort. If, after discussion, these few suggestions seem to be of general interest and possible fruitfulness, I will be glad, at some future time, to submit a more detailed and specific exposition of any, or all the work along this line, which I and my associates have been doing during the past year.

Discussion for Summer Meeting.

AN IDEAL CAR

By Herbert Chase*
(Member of the Society)

The preferences expressed herein are purely personal, and do not necessarily cover a good selling or manufacturing car, nor one suited to the needs of the average purchaser.

Body—Stream-line body, having a graceful and rakish appearance, with top and windshield, and provision for adequate protection in cold or stormy weather; normally seating two persons side by side, but provided with folding rear seat for two extra passengers, and room for tools and luggage.

Weight and Wheelbase—Maximum weight 1,800 pounds. Wheelbase 130 inches.

Motor—Four-cylinder, well-balanced motor, having a bore of about 3⅛ inches and a stroke of about 5¼ inches is preferred. (I can see no good reason for using a six-cylinder motor in a car of this size.) About 16 horsepower A. L. A. M. rating, capable of developing 45 horsepower at 2,500 r.p.m.; non-poppet valve motor, with preference for rotary type. Well made poppet valve motor not barred.

Transmission—A gasoline-electric transmission, giving eight forward speeds, is preferred. If selective-type gear-transmission is used, it should have four forward speeds.

Gear Ratio—A gear ratio of about four to one should be used, and the car should be capable of a maximum speed of not less than fifty miles per hour, and be able to run on high-speed gear as slowly as four miles per hour. To achieve quietness in operation, worm gear drive is preferred. Also double leather universal joints.

Unsprung Weight—The unsprung weight should be reduced to the lowest possible minimum, in order to reduce tire wear and trouble to a minimum. Probably the unsprung weight should not exceed 10 per cent. of the sprung weight.

*Laboratory engineer, Automobile Club of America.

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Control—Center control, with left-hand drive is preferred.

Type of Springs—The springs should, of course, be designed to make the car as easy-riding as possible. To this end they should be long and flexible. Probably semi-elliptic front, and cantilever rear springs are to be preferred.

Accessibility—All parts requiring attention from the driver should be made as accessible as possible; in particular, the carbureter, all portions of the ignition apparatus, and such parts as require hand-lubrication. These latter should be reduced to a minimum.

Wheels—Thirty-two inch wire or pressed steel, easy detachable.

Quiet Operation and Durability—All portions of the car should be designed to run as quietly as possible (attained by non-poppet valve motor, electric transmission and worm drive) and so proportioned as to give a maximum durability consistent with reasonably light weight.

ACCESSORIES

Carbureter—The carbureter should have but one adjustment, controlled from the driver's seat.

Magneto—High-tension type, independent of lighting system.

Lighting Generator and Starter—Combined with electric transmission.

A car of this description would be able to average 30 miles per gallon of gasoline consumed in straight-away running and have a low upkeep and operating cost when properly handled.

Discussion at Metropolitan Section Meeting.

THE IDEAL CAR

In opening the discussion, Chairman Anglada said that it was his idea to arrive at the specifications of a compromise Metropolitan Section car. "Let us put ourselves in the position of wealthy men," he said, "who have engineering instincts and want to build a car to suit our particular tastes. What kind of a car would we build?"

W. M. POWER:—I would suggest a small, high-efficiency, six-cylinder car; small bore, long stroke, with unit transmission. I would keep the weight down to the lowest possible consistent with safety. There would be no electric lights and no starter—nothing of that kind. The car would have wire wheels, and I think right-hand drive, with the ordinary controls, and single dry-plate clutch.

H. G. MCCOMB:—For my own personal use I would produce about the following: Six-cylinder engine of 3-inch bore and 5-inch stroke. I would not enclose the fly-wheel. I would have a very heavy, large fly-wheel, so that I would not have to be careful about stalling the motor in traffic. I would have a single-plate dry clutch; very long semi-elliptic

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front springs, three-quarter elliptic springs in the rear. A six-cylinder motor is the only one, in my opinion, that will give the greatest riding comfort. The wheelbase should be long for comfortable riding. The car should be kept as light as possible. It should have wire wheels, and as little "junk" on it as possible; perhaps a starter, because anything that adds to the convenience increases the value and usefulness of the car. The car would accommodate four passengers, with two extra seats to provide for a total of six persons.

L. P. PROSSEN:—I would probably take a taxicab and make it over into a runabout to suit me.

L. G. BUSBY:—Personally I would be in favor of a small four-cylinder motor, and do a great deal of gear-shifting. I do not believe in the present policy of trying to throttle down to two or three miles an hour on high-gear. To secure economy and light weight I would have a four-cylinder motor that would not throttle down on high gear, but would depend on manual gear-shifting. I have had no experience with the electrical gear-change mechanisms.

P. P. DEAN:—From my experience a four-cylinder motor is preferable for a light touring car. I have seen very good results from the valve-in-the-head engine. The car should have lighting and starting equipment, on account of the large number of women who use and run cars. I think the car should preferably be a roadster, with rumble seat, making a three-passenger body. It should have 32 x 4 demountable rims, and wood wheels. I believe in a unit powerplant, and from the experience I have had, a transmission with three speeds. L thing electrical gear-shifts work better than mechanical. A weight of 2,000 to 2,200 pounds is all right, from the standpoint of economy. The car should travel 20 miles on one gallon of gasoline. A 30-horsepower motor seems to cover the general demand for hill-climbing. In selling a car much depends upon its ability to take a reasonable grade without shifting gears. A 3¾" x 4" engine on a car weighing 2,000 pounds, properly designed, should take five passengers up a good hill at 20 miles an hour easily. I believe in gear-shifting, but the majority of purchasers do not understand it. I would have anything rather than a cone clutch, unless it were very well constructed.

W. H. ROBERTS:—I have not considered a car specially designed to suit me. The only cars I am interested in which would approach pleasure cars are those used by city officials. In the majority of cases such cars should be very light-weight and have enclosed body, to enable the occupants to spread out papers and maps without interference by the wind.

A. M. WOLF:—I would have a four-cylinder motor, L-head. It is desirable to have a passageway through the cylinder block from the carbureter to the inlet valves. The cylinders should be about 3½" x 5". The clutch should be either single or triple dry-plate. An interesting gear-box would be one put on the front end of the torque tube. One or two cars have been put out with this construction. The car should have bevel or helical bevel drive, and wire wheels. The body should be streamline, doing away with as many corners and small curves as possible

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It should have both battery and magneto ignition. A four-passenger body would suit me. Cantilever rear springs are ideal, I think.

F. C. WULF:—I would have an electric motor starter and generator; four-cylinder engine, L-head; magneto and carbureter on one side and generator on the other; wire wheels, and a four-passenger body. The drive would be bevel gear; the control left-hand with center levers. Size of motor, 4¼" x 5".

J. E. SCHIPPER:—I would have a 3" x 6" four-cylinder motor, four speeds, with fourth indirect, gear ratio, about 4 to 1, dry plate clutch, and wire wheels. I would like a body of the roadster type with two extra seats folding into the rear deck. The car would have worm drive, electric lights, dual ignition, cantilever rear springs, 34" x 4" wheels, and amidship gear-box on account of accessibility. The clutch would be arranged so it could be removed without disturbing the gear-box. All through the design of the car accessibility would play a large part in order to keep repair bills down to the minimum. In the average repair bill 60 per cent. of the charge is for taking down and putting together the parts. I would use hand-cranking until I see better work from batteries, which have to be renewed once a year on an average. Self-starting is, however, worth $40.00 a year when a car is used by a woman. I would have a small high-speed motor with at least 4-to-1 reduction in the rear axle. In the construction I would have feather-weight parts for all reciprocating elements. In order to have a motor of this size specified the parts would have to be light. There would be plain bearings on the crankshaft, unless I could find a good design of roller bearing that would be suitable.

A. C. WOODBURY:—I would have rotary valves in the head of cylinders, and multiple-plate dry clutch with asbestos facing. This is better than the cone clutch in my opinion. I think I would have the gear-box amidship. The size of the engine would be 3½" x 5" to 5½". The transmission would consist of two speeds and reverse, and a double-direct-drive rear axle, which I am surprised no one has mentioned. That would give four forward and two reverse speeds; the latter would be useful when a car has to be backed half a block or so. I would be in favor of pressed steel wheels having the external appearance of wood wheels, but slightly lighter, with demountable rims, cantilever rear springs and possibly one-quarter-elliptic front springs. There are several types of body that I would like to have. One that strikes me favorably is about the same as an ordinary two-passenger body with the seats set well back and a third seat beside the steering post, making a three-passenger body. Another attractive type of body is one similar to that called the suburban. It accommodates two passengers seated in front, and has a detachable rear seat, leaving a box-like compartment in the rear when the back seat is removed, which is useful for carrying luggage and for other purposes. The chief difficulty with this design of body is that it is exceedingly awkward to equip with a top; two tops, a short and a long one, being necessary. Possibly I would have simply a four-passenger stream-line body.

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W. P. KENNEDY:—My ideal is a light town car, a carriage more than a car. I would have a four-cylinder engine and the transmission combined with the engine in front, rather than on the rear axle, keeping the rear axle as free from weight as possible. I would have the car very well sprung, possibly putting supplemental springs under the power plant. If I could not get a body serviceable for summer and winter, I might have a very light interchangeable closed body for winter. I would have as many of the operating functions controlled by foot as possible. I would have a 3¾" x 4" engine, electric starter, electric lighting, and very low entrance to the body. I would have large tires and wood wheels.

E. J. BEURET:—I believe in a car capable of a maximum speed of about 50 miles an hour, and of throttling down to about 5 miles on direct drive. I favor the two-speed rear axle. I would not have the car too light, but something that would stand long, hard service. I believe in a copper water-jacket because it enables one to get uniform thickness of cylinder walls. I think that at the present time there is a dearth of medium-sized really high-grade cars. There is too much cry for light cars.

N. B. POPE:—My ideal car is primarily a two-passenger vehicle, rather low, with stream-line body, cantilever rear springs because of the reduced unsprung weight, and probably semi-elliptic front springs. The body would have a sloping deck in conformity with the stream-line practice, with a lid which could be raised, exposing two extra seats. For winter use I would have a body which would replace this, of coupé form seating three or four passengers. The second ideal in mind is absolutely simple control. The ideal method of control is merely a single lever; in the control system used on the Pennsylvania railroad one lever controls both the power and the brakes. As I now see, there is only one way of accomplishing this, by the electric transmission. I favor the electric transmission for other reasons, principally because with that form of drive it is possible to run the motor continuously at its most efficient speed and to adapt the application of the power to the load either to permit of high torque or high speed as the load condition may require. To obviate the ever-present difficulty of excessive weight in electrical machinery, I would resort to high speed. The electric motor would be of the series form, naturally. In order to reduce weight in both the gas engine and the transmission, I would have a very high-speed gas motor, probably about 2¾" x 5", four-cylinder. It would turn about 3,000 r.p.m. I would have pressed metal wheels of the artillery form, because they satisfy the requirements of cleanliness and also the requirements of strength. The motor starter and electric-lights would be taken care of by the power plant.

HERBERT CHASE:—I agree with the ideas of Mr. Pope and Mr. Schipper in many particulars, except that I think neither of them wants a non-poppet valve motor. I would like a rotary valve motor provided one can be designed that will work dependably. This is ideal and not altogether realized at the present time. The size of the motor would be about 3¼" x 5" and have an A. L. A. M. rating of about 15, capable of developing in the neighborhood of 40 horsepower at 2,800 revolutions or

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thereabouts. It would certainly have four cylinders. There may be some excuse for a six-cylinder motor in a very large car, but not for the car I have in mind. I doubt if one person in ten riding blindfolded behind motors of equal power can tell whether a four- or six-cylinder motor is furnishing the power. I am unable to see the advantage of the two extra cylinders and I do see several drawbacks. The transmission would preferably be electric, providing the weight of the car could be kept below 2,000 pounds. The type of body would be very much like the ones Mr. Schipper and Mr. Pope spoke of, two seats normally with an extra seat opening in the rear to accommodate two extra passengers and to give space for luggage. The springs in front would probably be semi-elliptic, and cantilever in the rear, with either a shock absorber or some kind of secondary spring. I would prefer wire wheels, or perhaps pressed steel if the latter type had been developed sufficiently to assure practicability. I prefer demountable wheels, they being lighter and quicker to change than demountable rims and not so likely to rust. The gear ratio on a worm drive would be 4-to-1. If it is impossible to have an electric transmission I would have a gear-box which would be four-speed, direct probably on fourth. I do not see any reason why a car of this description should not easily make 30 miles straightaway running per gallon. For city work it ought to average 25 miles. I believe that a carbureter of good design with a single adjustment should be fitted, and be able to give a speed on high gear as low as 5 miles an hour and a maximum of 50 miles. The parts of the car should be as accessible as possible and the motor should be very well balanced to keep the vibration minimum.

I would like to ask Mr. Power and Mr. McComb their reasons for wanting six-cylinder engines of about 3½ inches bore in preference to four-cylinder motors of equal bore.

H. G. McComb:—Easy riding. I have found that in ordinary running I could not tell that the car had a motor in it due to absence of vibration. With a four-cylinder motor there is some speed at which vibration is noticed. In a pleasure car I think the motor should go about its business with as little annoyance to the passengers as possible, and for that reason I would be willing to spend the additional money to put in the two extra cylinders. Having no vibration at any speed means a great deal to a man who wants a car for pleasure. Wide variation of speed without shifting gears means wonderful flexibility. It is pleasant to be able to throttle a car down and feel that the motor is going as usual. I have never seen a four-cylinder motor that gave the feeling of comfort and pleasure that the six-cylinder motor gives.

W. M. Power:—I think it is a question of ultimate refinement. I think that probably eight cylinders would be better, but this would be going a good way as far as upkeep is concerned.

Herbert Chase:—Personally I have not been able to see that the six-cylinder motor has not as much vibration as the four-cylinder. The longer crankshaft and less rigid construction of the motor, due to the

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extra length, I have found (at least in block testing) makes the motor subject to more periodic vibration than the four-cylinder.

W. M. POWER:—Is this due to poor construction?

HERBERT CHASE:—Possibly, but I know that at least two manufacturers of very high-grade six-cylinder cars in this country have had very serious trouble with vibration. One of the motors in question has a synchronous vibration at one speed which causes the power to fall off fully 30 per cent. from normal at that speed. It is difficult to get good distribution, particularly when the double exhaust is not provided.

CHAIRMAN ANGLADA:—I prefer an eight-cylinder V motor, with one camshaft, one source of ignition (magneto), fixed spark, a three-speed gear-box direct on second. The car would be able to do very nearly all traveling on second. I would have bevel-gear drive because manufacturers will sell worm-gear axles only with certain restrictions. I would have the foot-brake on the propeller-shaft. The body would be four-passenger with disappearing rear seats, V-type radiator and wire wheels with demountable rims. The dimensions of the motor would be probably 2¼" x 5", giving 42 to 45 horsepower. The motor would run very efficiently at very high speed, a maximum of perhaps 3,300 to 3,400 revolutions. I would have a single dry-plate clutch.

J. E. SCHIPPER:—What do you think of the spiral bevel gear as a compromise?

CHAIRMAN ANGLADA:—I would prefer that to the bevel.

L. P. PROSSEN:—I think pump water circulation is far better than anything else. I have had experienec with this type and with thermo-syphon. I think the radiator should have a flat front.

CHAIRMAN ANGLADA:—What have been your troubles with the thermo-syphon?

L. P. PROSSEN:—Overheating in summer and freezing in winter.

I want to explain a type of clutch that is very satisfactory. At each end of the cone there is a circular groove in which there is a round piece of rubber, similar to that on baby carriage wheels. The rubber is pressed into the leather, giving more smooth engagement. I have known this type to run as long as three years and not give any trouble at all. Even after the rubber breaks it can be removed and replaced without taking the clutch off the car. There is very little expense attached to it and it is very satisfactory.

CHAIRMAN ANGLADA:—From the standpoint of economy of manufacture or ease in replacement or ease of control does the disc clutch possess advantages over the single-plate dry clutch, or the single-plate and multiple-plate over the cone clutch?

W. M. POWER:—No doubt the cone clutch is cheaper.

HERBERT CHASE:—Three or four years ago Mr. Green, of the Fifth Avenue Coach Company, expressed himself as very much in favor of the cone clutch, but said he thought it should be made of a stamping, very light and flexible.

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L. P. PROSSEN:—That is all very well, but those clutches jam and stick.

CHAIRMAN ANGLADA:—The cone clutch on the Locomobile racing car gave excellent satisfaction. It was one of the few clutches in the 1906 Vanderbilt Race that did not give any trouble.

L. P. PROSSEN:—What is the best type of thrust yoke for taking the thrust on release of the clutch?

W. M. POWER:—The old type of cup and cone or ball bearing.

L. P. PROSSEN:—That never gave very good satisfaction.

N. B. POPE:—I am impressed with the lack of enthusiasm here for front-wheel brakes.

J. E. SCHIPPER:—If a diagnoal brake could be installed it would be a good thing. The tendency of a person in a moment of panic is to throw on the brakes suddenly. The diagonal brake would be a good thing in a case like that.

CHAIRMAN ANGLADA:—Do you think complication and extra weight would be a hindrance?

J. E. SCHIPPER:—That, of course, is the objection.

N. B. POPE:—I must confess that diagonal brakes seem unsymmetrical, but other than that they appear to be satisfactory.

J. E. SCHIPPER:—The automobile is the only vehicle of its size with which reliance is placed on manual power to apply the brakes. Of course, there have been other kinds of brakes—air and electric. With air there has been the difficulty of keeping the tank tight, and with the electric brake there may be a lag in getting the power applied to the rear wheels unless everything is keyed up to the top notch. The time consumed in getting up the speed of the motor is really considerable when you want to make an emergency stop, but I believe the time is approaching when the control of brakes will not be by hand.

It does not seem right that brakes should not have a longer life than they have at present. A brake used in a mountainous country has to be renewed every 400 or 500 miles to keep it in good shape. This condition would be improved if it could be run in oil.

N. B. POPE:—There are certain problems in automobile design which we can safely refer to railroad practice. In railroad practice there is no hesitancy about changing brake-shoes as often as necessary, and I see no reason why we should not acknowledge the fact that the friction we desire in the brake means wear. The thing to seek in brake design is the maximum amount of friction with a minimum amount of weight.

A. C. WOODBURY:—I have driven a car 12,000 miles in rough and very hilly country and renewed the brakes only twice.

H. G. MCCOMB:—I know of one concern advertising to guarantee all brakes for one year's service. It seems that this is based on experience.

HERBERT CHASE:—Would not the diagonal operation of brakes be rather hard on tires? I know there is considerable extra wear on one of the rear tires if one of the brakes is applied more quickly than the other.

O. A. PARKER:—I have driven 80,000 miles and renewed only three

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brake shoes. They are steel to steel.

CHAIRMAN ANGLADA:—Should the transmission have four speeds or three?

O. A. PARKER:—Four speeds with direct on third.

H. G. MCCOMB:—Three are all that are necessary. Keep the car as light as possible.

L. P. PROSSEN:—I do not see why the transmission should not be direct on high. If the transmission is properly designed you can use the high a great deal. We have four speeds direct on high, 4 to 1 gear. You can drive the car about 45 miles an hour and hardly hear the motor running.

CHAIRMAN ANGLADA:—With four speeds you can use a smaller motor. It is questionable whether you prolong the life of the motor.

HERBERT CHASE:—I very much favor the small high-speed motor because you can keep the throttle nearly wide open and get much more efficient combustion, due to the higher compression.

J. E. SCHIPPER:—You get better carburetion, also.

CHAIRMAN ANGLADA:—Who has given the subject of leather universal joints as used in the Isotta and DeDion any consideration?

HERBERT CHASE:—I think that about the hardest service to which you can put a universal joint is between a motor and an electrical dynamometer, where there is a "give and take" between the flywheel and the armature. I have known a two-inch shaft to shear off without any apparent provocation. In one 300-hour test I found that when the test was over the joint had worn so much that there was a play of nearly one-eighth inch. In the next test we made for 300 hours or a little over we used leather universal joints and there was absolutely no indication of any wear.

N. B. POPE:—I think that automobile designers almost as a rule are rather too much inclined to ignore the fact that there are two qualities to be considered—one independent and the other dependent. Take the case of the clutch. For one use the cone clutch is superior and for other uses the plate clutch is superior. You cannot determine which type is superior until you know what sort of car you are talking about. We have to guard ourselves very carefully in making up our mind on these various features and their relative importance. We should always take a certain type of car as the starting point. The thing that appeals to me in this connection is the number of speed-changes in the gear-box. If you plot the horsepower curve of the motor and the curve of tractive effort of the car in which you propose to put this motor, and then consider the sort of use to which you intend to put the car, you will find a safe combination. But if you follow one of these conditions without varying the other the conclusions may not be satisfactory.

CHAIRMAN ANGLADA:—I believe that an ideal set of characteristics should be possessed by any and every car irrespective of whether it is a touring car, a runabout or a roadster, characteristics which should apply to one car as well as another.

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Paper for Summer Meeting.

STARTING, LIGHTING AND IGNITION DEVICES

By Albion D. Libby*
(Member of the Society)

It would be impossible to treat in one paper any one of the sections of the above subject and do it justice; consequently it is not the object of this paper to discuss in detail each section thereof, but rather to state a problem, which includes the three sections, and then to offer a solution therefor. As units by themselves, each section involves its own problems, but when united on an automobile or other moving vehicle they become interlocking and hence in the general problem must be treated together.

The general problem may be stated in the following terms: The car must be cranked fast enough to secure carburetion under varying conditions of weather and fuel. The ignition devices must operate below the cranking speed and the lighting device must operate to light the car and furnish power for the cranking device.

We must show, first and foremost, reliability which means durability; second, simplicity; third, as low cost as possible without sacrificing reliability; fourth, as light weight as possible.

VOLTAGE

In the development of the starting and lighting system described particularly in this paper, a great deal of time and study was given to all existing systems in the United States and foreign countries. After the investigations it was decided to adopt a system based on the use of six cells of storage battery, giving a 12-volt system. The basis in working out the general problem is the voltage of the storage battery to be used. In the early days of the internal combustion engine, the first battery-ignition systems used were primary wet cells, later replaced by dry cells. Six volts was the pressure commonly used in these early ignition systems. After a while the dry batteries were discarded and a small storage battery consisting of three cells, giving approximately the same voltage as the dry cells, was substituted. Under these conditions the storage battery had to be removed from the car at intervals for the purpose of charging. At a later period some added electric lights to the car, the current being taken from the storage battery used for ignition purposes, or in some cases an extra battery of the same voltage as the ignition battery. During this period the batteries had to be removed for the purpose of charging. This became tiresome; the car owner began to inquire for a small gen-

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erator with which he could charge the batteries while running the car. Finally he asked for an electric motor to crank the car, the motor to be driven from the batteries which he had already installed. Thus we see that the six-volt system is the result of a great deal of patchwork; while a great many of the rough edges have been knocked off, yet it is the belief of the writer that it never has been an entirely satisfactory job, and probably never will be; that is, it cannot be made as satisfactory as a 12-volt system.

In view of the fact that the whole state of the starting and lighting and ignition art has grown up around the six-volt battery, the lamp bulb has become standardized for this voltage to such an extent that the adoption of any other voltage necessarily raises the question of the present increased cost of the higher voltage lamps. This is a question of demand. We all know that special products break up the general manufacturing routine and increase the cost of production. In order, therefore, to use voltages higher than 6, such as 18 or 24, as are being used to a small extent, it has been necessary to introduce more or less complicated controllers in order to throw the cel's in series for starting purposes and in multiple for lighting. Operating batteries in multiple is open to a number of objections which are no doubt familiar to many of you. It does not seem wise to introduce controllers or apparatus for switching the cell combinations into their various relationships; that is, we should have "simplicity." Six-volt systems, on account of the heavy currents carried, necessitate larger conductors for the wiring as well as more generous design in the starting motor and lighting generator; and are more susceptible to bad contacts at the commutator brushes and elsewhere than the higher voltage systems. It seems to me that 12 volts is a satisfactory mean between the extremely low voltage of 6 and the higher 24. The 12-volt system has all the simplicity of the 6 without the complications of the 18 and 24, and it has the "punch" necessary to make a starting motor "wake up" to its job of cranking the engine. It is possible to crank an engine with a 12-volt battery of half the ampere-hour capacity of the six-volt battery, even when the voltage across the starting motor brushes falls as low as six, while under the same conditions the six-volt system will fail at half the percentage of voltage drop. This will be found to be a valuable asset on many occasions. It is worthy of note that practically all European cars are built for 12 volts.

SINGLE OR DOUBLE UNIT

Much consideration was given the question of one or two units for starting and lighting. It seems that there should not be any question as to the ignition being kept separate from the other units. Two units avoid all complications in wiring, internal and external, and give the greatest reliability possible, as well as simplicity and maximum efficiency at a low cost. The units, being separate and distinct, can be installed on the car, in a great many cases, much more readily than the larger single unit; and if, for any reason, one of these units gives out, the other can be operated. The work required of the starting motor and lighting generator

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are diametrically opposite; consequently their characteristics are opposite to a very pronounced degree. The starting motor must be of a series type, while the lighting generator must have the characteristics of a shunt machine. It is a difficult problem to combine these two characteristics in one machine and get the same efficiency per pound out of the combination as can be obtained individually from the two separate units.

CLUTCH

On account of the jerky characteristics of a gasoline engine in starting, the requirements put on to the starting motor are extraordinary and the device used for making the connection between the starting motor and the engine in order that the engine may be connected and disconnected therefrom, must be a high-grade piece of apparatus. I consider, therefore, the clutch used for this work to be the most important part of the starting system.

I have never seen any friction, ball or roller clutch that would stand up over a long period of time under the strains produced in cranking an engine. When the engine is coming up to compression a steady strain is put on the clutch, but as soon as the point of compression is passed the moving part of the engine "runs away" from the clutch and there is a short interval of time before the clutch catches again. These continual blows will inevitably flatten any ball or roller that can be made, and as soon as they are worn flat the clutch begins to slip or stick. The clutch which will be described is absolutely free from these defects and so far as rigid tests can show, extending over a year's time, no weakness has been discovered in the mechanism. After fifteen thousand engine starts on one of these clutches it appeared to be just as good as it was when the first start was taken.

Fig. 2

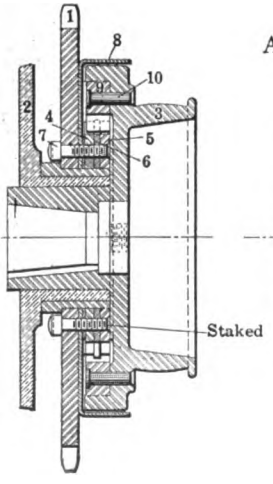

Fig. 1

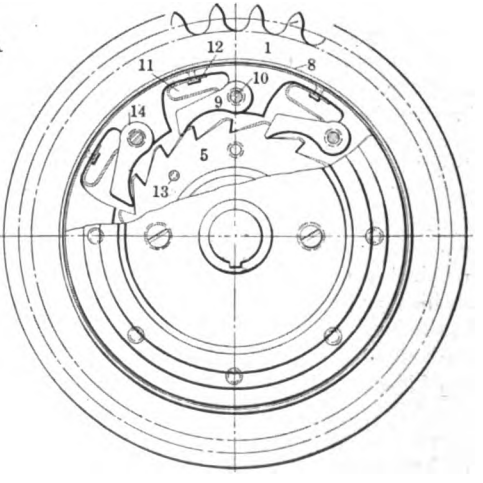

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Fig 1 shows an end view of the clutch with a portion broken away. Fig. 2 is a section of Fig. 1. In this particular clutch one of the clutch members 3, which is adapted to be keyed to the crankshaft, carries a flange for receiving the fan-belt; this particular construction to accommodate the fan-belt may or may not be used. Rigidly attached to this part are pins 10, which carry pawls 9. Resting on the pawls 9 are light springs 11 for the purpose of preventing any vibration of the pawls. The other element of the clutch consists of a ratchet element made up of three parts, 4, 5 and 6; 4 and 5 are steel, while 6 is a member whose function will be described later. These three parts are riveted together and the whole bolted to the sprocket wheel 1, a casing 8 being used to enclose the pawl and ratchet elements to keep out dirt, etc., 2 represents the end of the gear-case on the engine which carries a hub that serves as a bearing for the driving member. The pawls and ratchets are so arranged that when the car is standing idle there will always be one of the pawls *never* farther than .089 of an inch from engagement, with an 8-pawl element; consequently there is no shock at the moment of engagement or at the time of going over compression. When current is applied to the starting motor the driving member carrying the ratchets, one of which is in engagement with one of the pawls, begins to turn the pawl-carrying element, which is keyed to the crankshaft. When the engine picks up of its own power the pawls are thrown back into the recesses provided and out of engagement with the ratchet-wheel, and will stay there until the car is stopped, when they are returned to position by the springs 11. However, to overcome any possibility of the pawls dropping down and making a noise, when driving at a very low speed on direct drive, the noise-killing element 6 is introduced for the purpose of receiving the pawls as they drop down into position. The mounting of pawls 9 on pins 10 is such that absolutely no strain is put on the pins 10, the strain being carried by the abutment back of the pawl. It is seen that the driving member is idle while the engine is running.

Fig. 3 shows the characteristic curves of a small-size starting motor used in the system. Fig. 4 shows the application of a starting motor and clutch to a six-cylinder Winton car. The curves shown in Fig. 3 were taken from this particular motor.

STARTING-MOTOR DRIVE

Attention is here called to the necessity of getting a direct drive for the starting motor to the crankshaft of the engine. I have seen a loss of 100 per cent. in the amount of power taken by an indirect application of a starting motor on account of the engine design being such as to accommodate the starting motor only at one place so that it might look out of the way. Where the drive is short and direct, as indicated in Fig. 4, the loss of power in the reducing gear is very small.

GEAR RATIO

The best gear ratio for one make of car may not be the best for another. It is my belief that a four-cylinder engine should be cranked

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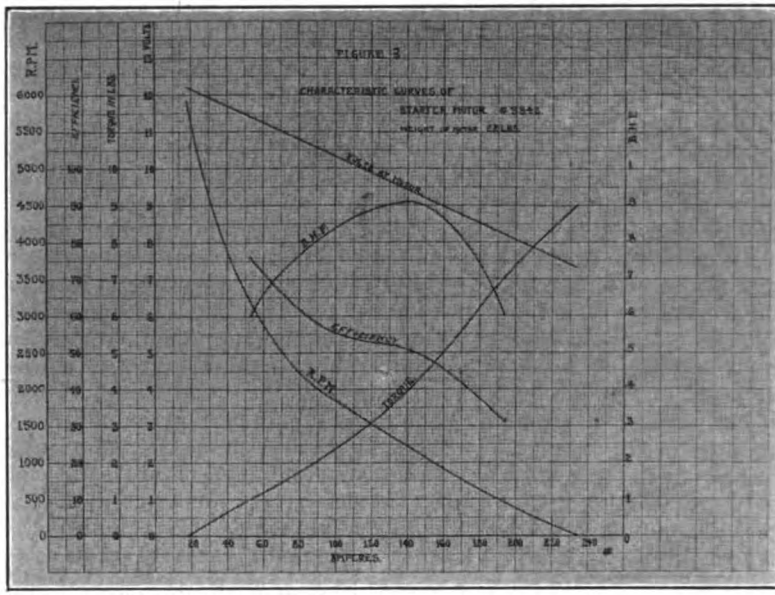

Fig. 3.

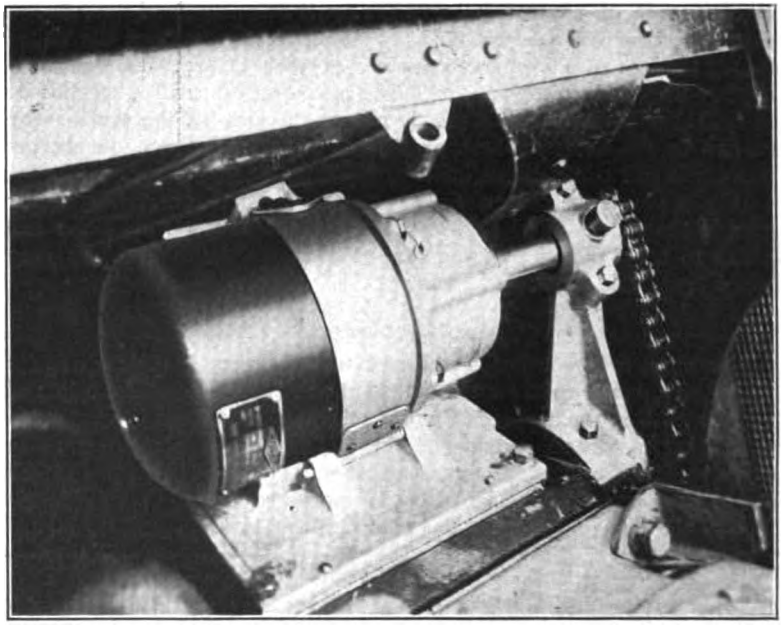

Fig. 4.

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at from 100 to 135 r.p.m. in order to take care of varying conditions previously pointed out. It seems to me that anything beyond 135 r.p.m. is a waste of power; and if the engine does not start at this speed something which should have attention is wrong. The general rule should be to crank the engine fast enough to get carburetion under varying conditions and have a good factor of safety by the expenditure of the least amount of power. On a certain installation with a gear ratio between the starter and the crankshaft of 25.12 the initial current was 120 amperes, and the running current 60, the voltage being 10.6. Under these conditions the engine was cranked at 120 r.p.m. The same engine was cranked at 177 r.p.m. by changing the gear ratio to 16.9, the initial starting current being 135, and 70 while running. These figures merely indicate that it is best to do a little experimenting on any installation before deciding on the gear ratio to be adopted.

LIGHTING

In the November, 1913, issue of the Proceedings of the American Institute of Electrical Engineers, A. E. Waller presented a very interesting and valuable paper covering various features involved in the lighting of a motor car. He treated to some extent the different types of lighting generators and the method of connection to the engine. In general, the installation of the generator has become a comparatively simple problem and will not be touched upon here other than to show one or two examples.

The lighting generator must work automatically; that is, it must be automatically connected to the battery at the proper car speed and must also be automatically disconnected from the battery when the speed of the car is decreased to a point where the battery and dynamo voltages are balanced. The dynamo must be self-regulating so that the charging current cannot exceed a certain predetermined point, and this regulation should be accomplished by a minimum number of parts practically indestructible and independent of external influences. The battery should have plates of such size as will take the maximum charging rate of the dynamo for a long period of time without detriment. Having a battery and generator with these characteristics it should be impossible to injure them by driving at a high rate of speed for a number of hours during the day time. In a new type of lighting generator in which the armature is supported on the usual ball bearings, the field poles have extensions which carry coils for the purpose of aiding in the regulation. Extending across the polar projections is a keeper supported by a good substantial spring, and associated with this is a spring used for the purpose of adjusting the tension on the first-mentioned spring. The circuit to the battery is closed by the action of the keeper when it is drawn toward the pole tips under the influence of the magnetic flux therein. The coils around the polar extensions are wired in series with the armature. When the current in the armature reaches a certain predetermined value, the keeper is drawn all the way down and an auxiliary contact is opened, cutting in a resistance with the shunt winding, reducing the flux due to the shunt windings, and this, together with the differential action of

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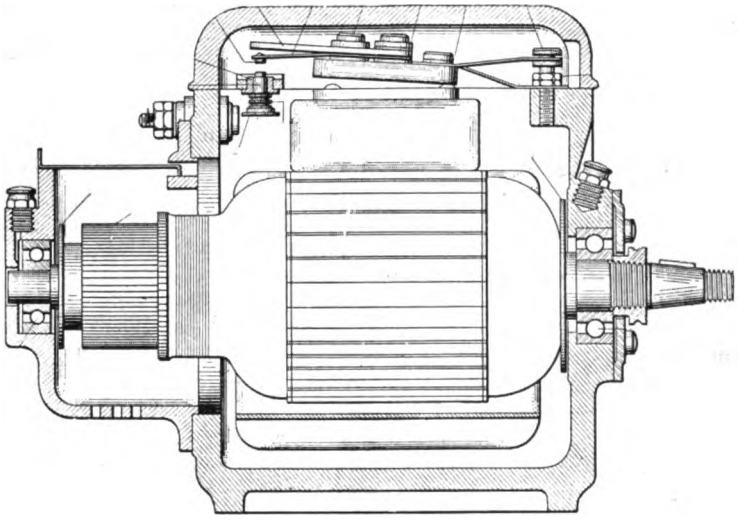

Fig. 5.

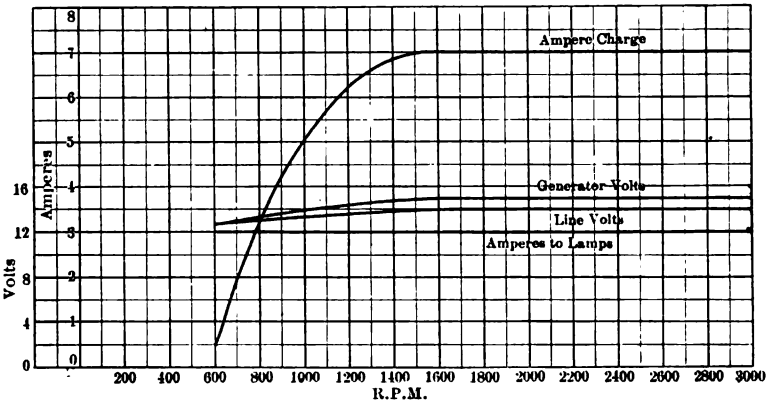

Fig. 6.

the series coils on the polar extensions reduces the magnetic flux through the armature to such a value that the current to the battery does not increase beyond a certain value, no matter how fast the armature is turned. The reverse operation of the controller takes place as the speed diminishes. A sectional view of the machine with the cover removed is shown in Fig. 5. The performance of this machine is illustrated in Fig. 6, from which it will be noted that the high-speed cut-out comes into action at the speed of about 1500 r.p.m. At this speed the current is

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7 amperes, which is considered a maximum charging rate for a 60-ampere-hour, 12-volt battery. This particular generator is designed to run at twice crankshaft speed, and when installed on a car geared 3.7 to 1, with a 34-inch wheel, begins to charge the battery at about 7 miles per hour. The high-speed control comes in between 35 and 40 miles per hour, the lamp load being carried at about 17 miles per hour.

A number of tests have been made on this system to determine how long it would take to build up the battery (50 A.H. capacity) after having thoroughly discharged it by running around city streets, carrying the entire lamp load, and operating from two to three hours each evening. It was found that within a week's time the battery was back to its normal gravity and voltage. Attention is called to the fact that the entire controlling mechanism for the generator is contained within its housing and but one pair of wires need be run from the generator to the battery. When the cover is taken off by removal of two screws the controller and main-line contact are within plain sight and easy access. This machine is entirely self-controlling and the movable element is independent of dash-pots, liquids, frictional devices, pivots, oil, grease, graphite and centrifugal devices, and is substantially independent of gravity and shocks on the road. The regulator is not subject to wear except at the contact points, and therefore does not require any adjustment other than that provided in order that one who drives very little during the evening may set the regulator so that the maximum current will not run above 5 to 6 amperes. The control of the machine is such that a short-circuit across the brushes will not injure the machine.

WIRING

Fig. 7 illustrates four circuit arrangements which may be used. In the arrangement marked *A* the head lamps are 7-volt and wired in series, using grounded sockets and being controlled by a double-pole single-throw switch. The same arrangement is used for the side lamps, while the tail and dash lamps have metallic sockets wired in series, using 7-volt lamps. It will be noted that with this arrangement there is no change in the lamp bulbs or sockets now used with a 7-volt grounded system, the only addition being a double pole on the switch and one extra fuse, two being used in each of said circuits. A fuse is also shown in the main line leading to an ammeter. A fuse is also shown leading to the starting switch. *G* is the generator and *A C* represents the automatic cut-out contained within the generator itself as has been described. The question of starting-fuses will be referred to later. The fuses for the starting circuit as well as the lighting and generator circuit should both be placed as close to the battery as possible. Circuit *B* uses 14-volt lamps for the head and side, metallic sockets being used throughout. The circuit arrangement *C* uses 14-volt lamps for the head and side, but a grounded system is indicated throughout. Circuit *D* provides for 7-volt lamps throughout, the head and side lamps being wired to a neutral connected to the center of a 12-volt battery. As mentioned in the first part of this paper *practically* the only objection to the use of

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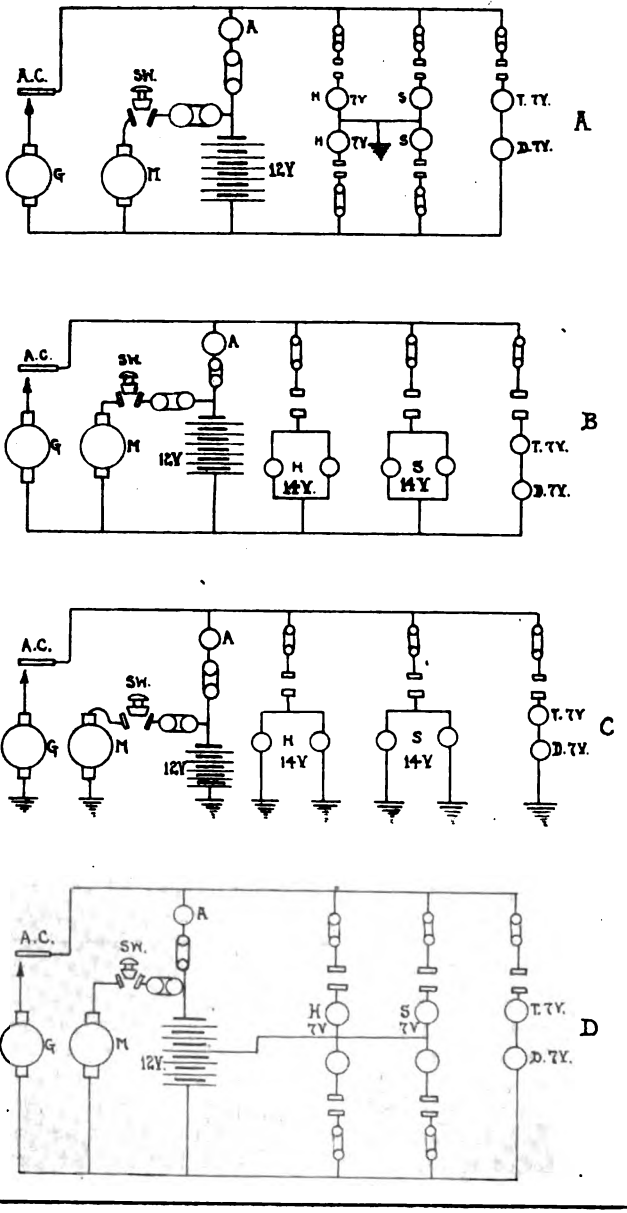
Fig. 7

LIGHTING CIRCUITS.



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a 12-volt system at the present time lies in the fact that 14-volt lamps are more expensive than the 7. All the lamp bulb manufacturer needs is an order large enough to make production an item.

I note that the Electrical Equipment Division of the Society has recommended a single-wire grounded system. I feel that this is a mistake, particularly as no more attention to protecting the battery leads is given than is now in vogue. I have seen recently a new car within a hair's breadth of burning up on account of being wired for a grounded system, one of the battery conductors encased in a flexible conduit becoming crossed with the sheath which was grounded to the frame of the car. The result of this was to melt the flexible metallic sheath until it ran like molten lead. The heat set fire to another piece of apparatus in the dash close to an auxiliary gasoline tank.

I notice that in Mr. Davis' article on the "Ideal Car" he states that his car should give 8 years of satisfactory service. It is beyond belief that any one will drive a car for 8 years without some wire connected in the starting or lighting system becoming grounded, and I ask in all seriousness what is going to happen should this ground come on the main battery lead to the starting motor, generator or lighting bus-bar? Something is bound to happen. The car owner may be fortunate enough to get off with a burnt-off battery lead but may encounter something more damaging. By the use of a complete wire system one has two chances and it is only a matter of five or ten minutes to have the car tested for grounds at intervals of every three or four months. Suppose a car were wired with circuit *A* of Fig. 7; should a ground occur on one of the battery leads leading say to the positive side of the battery, the head and side lamps connected to this side of the battery would be shunted out, and if one of the lighting switches were pushed the full voltage of the battery would be thrown across the lamp. The fuses connected in this lamp circuit should be of such a size as to take care of this increased flow of current but, supposing for the sake of argument, that it did not, the worst that could happen would be the probable burning out of the lamp connected to the negative side of the battery. This would be far better than the loss of the entire car which might happen, should a ground come on one of the main battery leads of circuit *C* without a fuse close to the battery as is now the practice. It might be argued that if circuit *C* is used, a car owner should have his car periodically tested for grounds, but while we might reasonably expect him to do this, the chances are that he would not, and for that reason it seems to me it is preferable to give him *two* chances instead of one. One objection which may be raised against the use of circuit *A* is the use of double-pole switches and double fuses. The function of the latter has already been pointed out. If single-pole switches were used the lamps would be subject to unbalanced conditions: for example, suppose the head lamp switch was in the "off" position, and the side lamp switch in the "on" position; then the one side lamp would be way above normal candlepower, and the other way below, and one head lamp would be dimly lighted. Double-pole switches should be used with this circuit, which is sug-

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gested as a means of using 7-volt bulbs with grounded sockets. With all the objections pointed out it is a safer circuit than *C* without the fuses as shown. Some of the objections raised against circuit *A* may be cited against *D*, and in addition there is some tendency to unbalance the battery if different candlepower lamps are used, but experience with this circuit shows that this objection has no weight because the battery is kept properly charged. It seems to me that circuit *B* is the right circuit to use on the "Ideal Car."

Up to the present time practically no attention has been paid to the question of fusing the battery lead running to the starting motor. I submit that this should be done for the same reason as has been set forth for fusing the battery lead running to the lamps. I have seen starting motors become grounded at the brush holders. When such an accident does occur then on account of the large leads used in this circuit an extremely heavy current flowing through the grounded section is very apt to start some fireworks. Only a short time ago a case of this kind did occur; a bolt head on the framework of the car wearing through the protecting cover of the cable of the starting battery lead, grounding the wire and the heavy current flowing over the wire melting the insulation off so that volumes of smoke were pouring from the car. Quick action in removing the battery lead from the battery took care of the trouble.

I have used the following specification for a starting fuse for a 12-volt system with excellent results. I do not give it, however, as a final result:

1—The starting-fuse must stand instantaneous flashes of 300 amperes.

2—It must carry 175 amperes for 5 minutes.

3—It must blow at 225 amperes cold, without having been previously heated, in 15 seconds.

Such a fuse can be made very cheaply, and it seems to me is a necessary adjunct in the proper wiring of the car.

INDICATOR

I do not believe any car-lighting system is complete without an indicator in the charging and discharge circuits which will show accurately what is taking place within these circuits. An off and on indicator may show that the dynamo is connected to the battery but something may be wrong, and only a small part of the current that should be in the circuit may be flowing and the driver have absolutely no knowledge of what it going on. I believe every car should be equipped with a suitable ammeter as indicated by *A* in the various circuit arrangements shown in Fig. 7. In instruments used on automobiles it is essential that they be of such construction that the violent jarring due to vibrations of the dashboard will not affect them as regards accuracy or mechanical stability. It is commonly found that the vibration of the dashboard will cause parts to work loose if these are not properly designed or securely fastened. Here again reliability and simplicity are the key-notes. The vibrations of the dashboard will also affect the operating characteristics of the instrument in that they produce vibrations of the pointer, thereby making it

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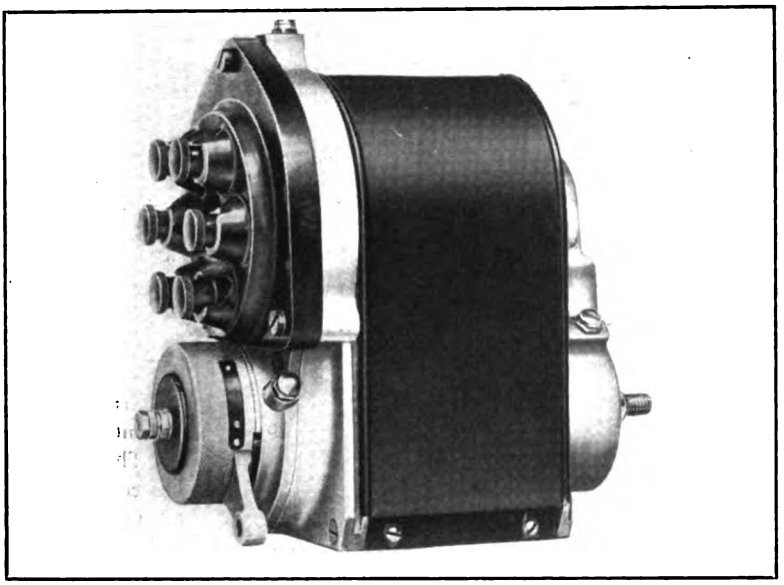

Fig. 8.

difficult to obtain a reading. These vibrations may be in synchronism with those of the dashboard or they may be irregular due to the controlling springs of the instrument oscillating back and forth or up and down as the case may be, on account of the springs as ordinarily used being rather long and comparatively weak. As is well known, the deflection of an indicating instrument of the permanent-magnet type is produced by the current passing through a movable coil pivoted so that it can swing in a magnetic field, the force thus produced by the coil being opposed by the previously mentoned springs. The moving coil is capable of taking a certain number of turns and a certain amount of current, depending upon the potential applied to the moving coil which in an ammeter is the same as the potential across the shunt. It is evident that the stronger the springs are the more definite and more rapid will be the indication of the instrument. The rapid action of the moving system will serve as an indication of variable contacts due to loose connections, etc. A sluggishly moving system whereof the amount of inertia is great would not indicate these defects, or at least only to a very small degree. It is also important to make the moving system light, but not so light that it will suffer in mechanical stability, which is a very important feature in an instrument mounted in the dashboard as it is likely to meet with violent abuse in garages during repairs to the engine. While in an ordinary instrument the lines of force enter and leave the moving coil horizontally, acting only on the two vertical sides of the coil, the lines of force in a recently developed instrument enter the moving coil on all sides

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of the same, thereby rendering its action more effective; first, by gathering in the stray lines of force; secondly, by utilizing every unit length of the coil winding whereby efficiency is increased about 100 per cent. over that of ordinary instruments. This results in a strong torque which enables the use of strong controlling springs. Another remarkable fact about this instrument and a direct result of the efficient arrangement in the magnetic field of the moving coil is the perfect damping and rapid action of the pointer when using an air-gap of more than 1/16 inch. The moving element has no pivot base such as is ordinarily used in other instruments, and usually glued to the insulation of the wire wound on the moving coil. On the other hand, part of the frame on which the wire is wound is bent so as to form a substantial support for the pivot, bridging across the wire on the coil. The pivot is mounted securely on these bridge poles by means of a shoulder and nut. This construction prevents turns of the coil becoming short-circuited, a common fault in ordinary instruments. The wire in the moving coil is released from all mechanical stresses and is perfectly insulated from all metal parts. The springs used in the instrument are so strong that vibrations of the dashboard do not affect the indications. The convolutions being spaced widely apart, there is no possibility of their touching each other. Temperature tests show that with a difference of 40° F. the instrument reads 1.9 per cent. high, as against 3 per cent. for another well-known make.

IGNITION

I have pointed out what seem to be the essential requirements in a starting and lighting system and shown methods and apparatus for accomplishing the work in a simple and reliable manner. I now come to the last but yet very important section of the subject, ignition. Having stated that ignition devices must operate below the cranking speed, I wish to describe briefly two new types of magneto constructed particularly for easy starting without the use of battery, auxiliary coils, or any external devices Fig. 8 is an assembled view of a six-cylinder high-tension magneto. This view shows the water- and dust-proof construction. The important dimensions, such as concern the location of the holes in the base, and the distance from the holes to the beginning of the taper on the shaft, etc., conform in every way to the S. A. E. standards. In Fig. 9, *A* is a view of the armature showing the collector spool, bearings and circuit-breaker. *B* illustrates a sleeve construction mounted within the pole-pieces, rotatable with the advance lever. The armature *A* turns within the sleeve *B*. From this construction it will be seen that for any speed the break is always in the same position relative to the sleeve; that is, there is practically no difference in the strength of spark when the break is in advanced or retarded position, the speed remaining the same. By this construction an advance of 75 or 80 degrees is obtained, which is essential for long-stroke slow-speed six-cylinder engines.

As is generally known, the orthodox high-tension magneto is of the bi-polar type, and in order that the sparks should occur at the proper intervals the armature of the magneto must be rotated at one and a half times crankshaft speed when attached to a four-cycle six-cylinder

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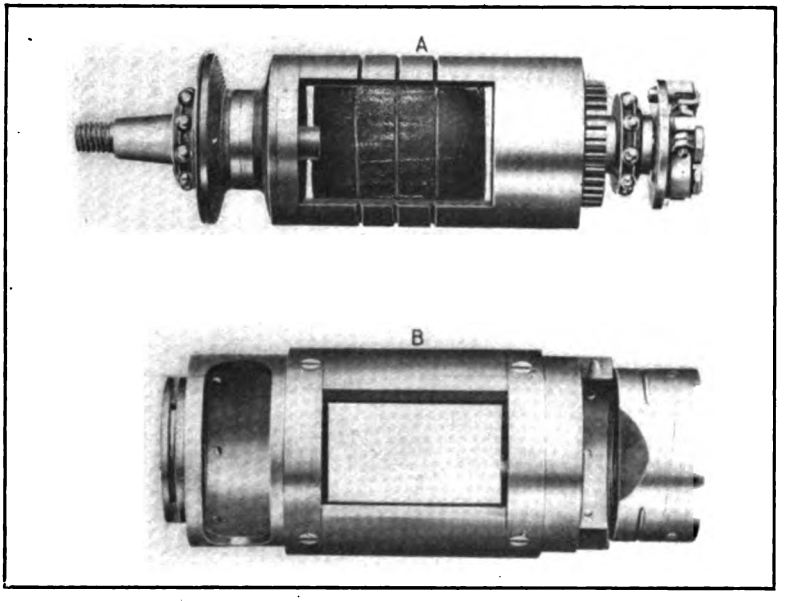

Fig. 9.

engine. Since the usual high-tension magneto does not deliver reliable sparks at the lowest engine speed, over a range greater than 35-45 degrees, the available spark advance, when referred to the circumference of the flywheel, is but two-thirds of the above, namely, 23.3-30 degrees. Hence when the piston is at top center on the compression stroke, even a spark advance of 30 degrees will generally be found insufficient to enable the engine to deliver its full power. The usual procedure to overcome this late ignition is to use a little richer gas mixture, and as a consequence when the car is driven at high speed for an extended length of time, most sixes manifest a pronounced tendency to become overheated. With an available spark advance of 50 degrees on the flywheel the necessity for richer mixture is dispensed with and the tendency to overheat, caused by the combination of late ignition and rich mixture, vanishes. Many of the six-cylinder cars can be throttled to a very low speed on direct drive but do not have starters which will crank the engines more than 25 or 30 r.p.m., and hence recourse must be had to auxiliary devices to give a spark strong enough to start the engine.

Fig. 10 presents a *distinctly* new type of high-tension magneto, which contains many interesting and valuable features, the first of which is seen in the above figure. The breaker is so constructed that the platinum points are external to the main breaker-box. These points are shown at 9 and are covered by a cap held in place by spring-catch 13. By this construction it is possible to observe and adjust the breaker-points, if

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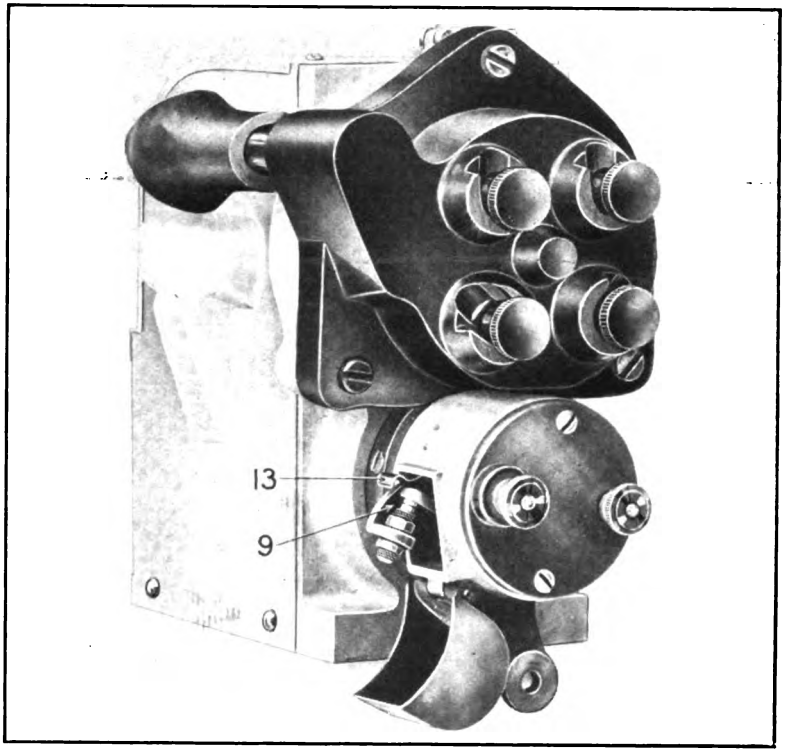

Fig. 10.

necessary, while the magneto is running. At the same time the points, being carried externally to the main breaker-box, are removed from the presence of oil, which is detrimental to the action of the spark points but essential to the wearing of the breaker itself. Fig. 11 is a side view of this machine with the dust- and water-protecting casing removed and one of the magnets withdrawn. No screws are used for holding the magnets in position and as soon as the side covers are removed the magnets can be taken off. This view shows the coil *C* (shown in Fig. 12) with its core *5* resting on field-pole pieces *1* and *2*. The coil *C* can be readily removed by taking out two screws *14* and disconnecting the primary lead *8*, which is attached to the side of the coil. An important feature of the coil is that the heads are of insulating material and there is not the tendency for the high-tension current to jump to the side as in the ordinary armature type magneto. The high-tension lead is brought out to a connector *6* and carried to the insulated high-tension lead running to the distributor by means of a special connector *7*, no collector spool being necessary. It will be seen that this disposition of the windings makes them readily accessible and lifts them up out of the lower portion of the magneto where they are

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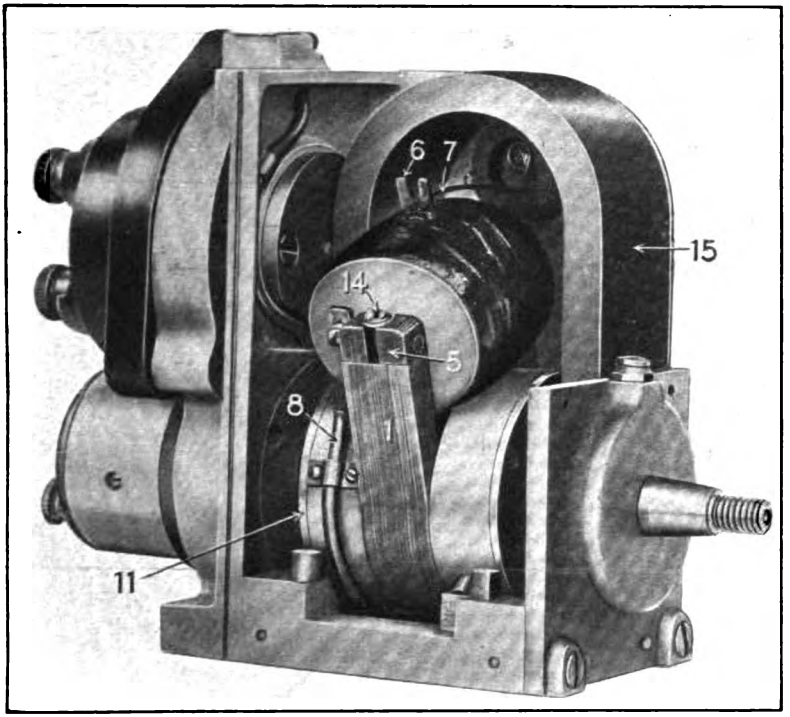

Fig. 11.

mounted in the ordinary type of magneto. The parts are shown more clearly in Fig. 12, which will also serve to explain the principles involved in the operation of the magneto. *A* is the field-pole structure consisting of a non-magnetic shell, assembled to which are the field-pole limbs *1* and *2*. Mounted on suitable bearings is a rotor *R*, having two rotor pieces, *3* and *4*, between which is a block of non-magnetic material serving to hold the entire rotor structure together. The rotor pole-pieces run in close proximity to the flanges *11*, and when the machine is assembled the magnets *15* (Fig. 11) fit within a space *12*, against the flange *11*, one magnet on either side of the shaft. It is thus seen that the rotor *3* is *always* of *one polarity* and the rotor *4 always* of the *opposite polarity;* consequently there is *no change* in direction of the magnetic flux through the rotors; the only reversal of the magnetic lines takes place through the laminated pole-pieces *1* and *2* and the core *5* of coil *C*. This causes a short free path for the reversal of the magnetic lines and hence the hysteresis and eddy current losses are reduced to a minimum. The result is a most efficient magneto per pound of material.

A light-weight magneto of Fig. 10 type will throttle down to 60 r.p.m. with a .025" plug gap under 65 pounds compression. This is over 100

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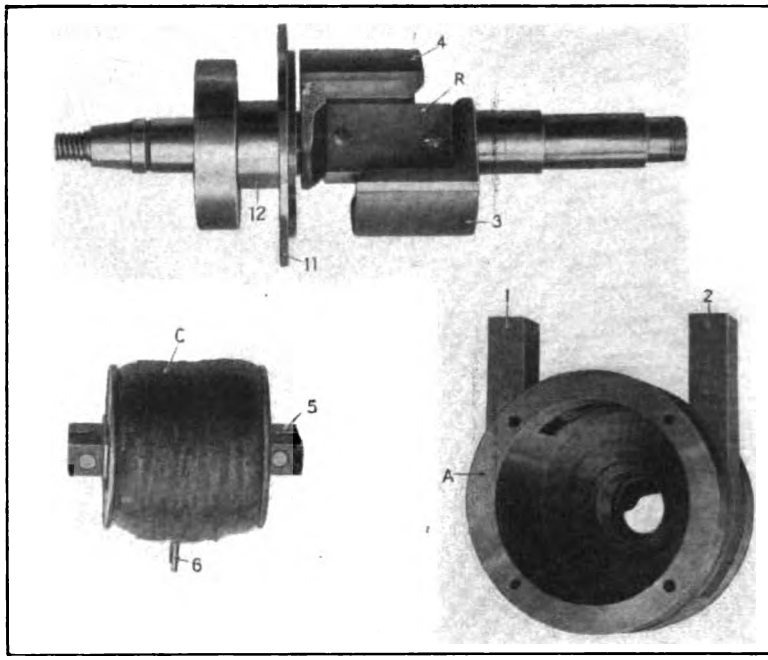

Fig. 12.

per cent. slower than any engine will turn over on its own power and well below the limit for cranking speed mentioned in the first part of this paper. With either type of magneto there is no excuse for having batteries around the car for ignition purposes. All that is necessary is a simple switch on the dash for shorting the magneto when stopping.

Whether or not the theory is correct, that the explosive charge contains numberless small spheres of hydro-carbon floating in air, the spheres having an outer layer too weak to burn quickly and next gas stratum of the right composition, followed by a layer too rich for immediate combustion and a center of unvaporized gasoline, or whether some other theory holds good, the fact remains that the charge under compression must have something more done to it than mere "piercing." The spark must carry heat in order to actually burn "any old" mixture that may be present.

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Paper for Summer Meeting.

CHARACTERISTICS OF AN AUTOMOBILE ENGINE LUBRICANT

By David L. Gallup*

(Member of the Society)

It may be believed by many that a discussion of anything relating to the characteristics of an automobile engine lubricant is not only unnecessary but undesirable for the reasons that it has been taken up so many times before, has in all probability been sufficiently well covered and also that further consideration of it may result in needless confusion. In the minds of a few, at least, recent developments have led to the belief that if ever there has been an established verdict regarding the proper qualifications for an automobile lubricating oil, it is rapidly becoming less recognizable due to the influence of commercialism upon engineering. Various articles have appeared in the technical papers from time to time in which conclusions have been given concerning the proper fire, flash, viscosity, gravity, color, and cold tests and origin of oils best suited for lubrication of an engine, but seldom if ever have they been in agreement even as to essentials. The question may be immediately and properly asked why this discrepancy exists. It is undoubtedly a bold statement to make, but is nevertheless capable of almost proof, that many oils are made to appear valuable as lubricants by reasons made to fit the case. In particular, if a manufacturer has available an oil of certain characteristics in such quantities as to make sale of it desirable, it is often necessary for him to invent reasons why that particular oil is superior to others and well adapted for the purpose under discussion.

It is not the intention of this paper to state definitely of what numerical values the various physical characteristics should be, since it is believed that this is not possible, but at the same time it is claimed that it can be stated what they should *not* be. Further, it is the author's conviction that in the case of modern oils of established standing, certain characteristics may be eliminated from consideration entirely as they in no way affect the qualities of lubrication. These are the fire, gravity and color tests, the locality from which the oil comes, and indirectly the cold test. Before going into an explanation of the reasons for this, let certain things be recalled to your minds.

"Gravity," when referring to an oil, indicates its weight, using water as a standard; is usually given in Baumé and varies ordinarily between 25 and 32 or 0.90 and 0.87 specific gravity.

"Cold Test" is indicated by the temperature below which the oil ceases to flow or exist as a fluid.

*Professor of Gas Engineering, Worcester Polytechnic Institute.

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"Flash Test" is the temperature at which the vapor given off by the oil takes fire.

"Fire Test" is the temperature at which the oil itself takes fire and is of course above the "Flash Test" (usually 30° to 50° F.).

"Color Test" is determined by the eye and needs no explanation.

"Viscosity" is a measure of the thickness of an oil and is measured by a "viscosimeter" in what might be termed an arbitrary way, being indicated by a numerical value. The various oils used in automobile lubrication vary in viscosity from 150 to 2000.

"Origin" in this case refers to the geographical locality in which the oil is found.

GRAVITY

Taking up now the explanation previously referred to, let "Gravity" be discussed in order to determine just what its influence is upon the oil as a lubricant. Viewed alone, it must be admitted that a variation from 0.90 to 0.87 can have little if any effect upon the oil in its ability to penetrate recesses or clearances according to whether it is light or heavy. Unless there be some link connecting the gravity of an oil with certain chemical characteristics which determine its lubricating value, it cannot be said that the value of gravity in any way determines whether an oil will stand up under severe heat. As a matter of fact, the only argument which has ever been used in connection with the effect of gravity is as indicated above, but as can be seen under the severe conditions of heat, speed and pressure, this slight difference can in reality have no determinable influence.

COLD TEST

The "cold test" value is indirectly related to an oil in regard to its value as a lubricant for the reason that oils having relatively high cold tests may give trouble in cold weather, but only when the engine is in the process of starting up. Immediately upon functioning, the engine imparts heat to all surrounding portions, so that at best it could be but for a short time that there would be possibility of insufficient lubrication. As to there ever being a time when oil on the bearings in some form did not exist, this is hardly conceivable. The only real detriment would be in the amount of power necessary to turn the engine by hand, mechanically or electrically, which might be of sufficient magnitude as to actually prevent this. This consideration, however, is hardly worth discussion unless an oil has a cold test above an ordinary temperature such as 20° F. and a viscosity relatively high.

FLASH TEST

The "flash test" in an oil of reputable manufacture is without question one of if not the most important characteristics. It is on this in reality that the life of the oil depends. Aside from its other qualities as a lubricant, the flash test, if less than a certain value, may preclude entirely consideration for use in an automobile engine. No one would seriously consider for a moment the use in an internal combustion engine of a so-called "machine" oil. The gravity, viscosity, color and cold tests might, however,

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be in agreement with many brands of automobile lubricants. The distinction is solely in the value of the flash test. The ordinary man reasons that this is as it should be, since the temperature to which the oil is subjected would affect the oil. What is particularly interesting, though, is that some manufacturers lay great stress on the fact that the oil in an automobile engine should *not* have a high flash test, maintaining that it should be low in order that the oil may burn up cleanly. Is it out of place to ask right here, What is the function of a lubricant, to lubricate, or burn up and furnish heat for the engine? If the latter, why not go a step further, using an oil such as is used on journals, lathes, etc., having a flash low enough to guarantee complete combustion. The argument concerning "burning up clean" has come to the front in a very decided manner recently, and is exceedingly unfortunate, for it would seem that actually it has been made to fit the oil rather than to obtain an oil which satisfies certain conditions primarily laid down as essential.

The proper and sole function of an oil should be to *lubricate*. It can be distributed in a way so as to be used over again or in a manner which will provide for its complete utilization, and this by *wearing* out or *evaporation* but not by burning.

To return, an oil is made up of certain constituents, the combination of which gives to it definite characteristics. If any one of these is changed or removed, that oil has a different lubricating value. Hence, any oil which is subjected to a temperature exceeding the value of its flash test, will have certain portions distilled or burned off, with the result that the oil has deteriorated as a lubricant. Therefore, the logical conclusion is that other things being equal, the flash test should be as high as possible, in order to be proof against this deterioration. The exact value of this is of course difficult of determination, and will need to be governed largely by experience. Results of tests extending over a long time have emphasized the fact that it should not be less than 400° F. approximately. An oil having a lower flash test is burned away rapidly and needs to be replaced by an additional supply; it is very often the case that even though the cost per gallon of the low flash oil is less, the total expense for oil alone per year is more than would be the case with a more expensive high-flash oil; saying nothing of the injurious effect which the inferior oil has upon the bearings.

Theoretically, an oil may burn up clearly; *practically,* no such thing exists. Oil is composed of H and C, and in order to burn "clean" must have complete combustion, which must be brought about by the proper proportion of air and the correct temperature. These demands are almost impossible of fulfillment in ordinary operation. With gasoline a very considerable range of proportion and temperature may exist without seriously impairing the efficiency of burning, but this is not so with an oil used as a lubricant. On the other hand, it is inconceivable when an analysis of conditions is made, to consider that *no* portion of a lubricating oil is burned away in an automobile engine; hence the aim should be to make whatever amount *is* burned as small as possible.

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RUNNING TEMPERATURE

In passing, it might be well to state that means should be provided in any automobile engine for keeping the lubricating oil as cool as possible. This refers particularly to the oil in the crankcase and results from the fact that a hot oil cannot be depended upon for lubrication under severe conditions to the extent that a cool oil can. Hot oil is constantly giving off vapor which in turn reduces the oil to nearer its basic constituents, resulting in a very different lubricating value. A few makers of engines are aware of this fact and are making provisions for it.

FILTRATION

Another important item for consideration is filtration. In any "over-and-over" system provision should be made for not only "straining" the oil but "settling" it, since straining merely takes out the heavier particles of foreign matter and does not remove that which is in suspension. In all probability a form of settling basin, with a less rapid rate of circulation, would be of material assistance.

FIRE TEST

Coming now to the "fire test," it is maintained that since this is always higher in value than the flash test, and since above the latter an oil is changing in its characteristics and bears little resemblance to itself under normal conditions, there is no need of consideration of this item. The flash test of a given oil determines for that oil its value as a lubricant.

COLOR TEST

The "color test" fortunately is not given the prominence it formerly had, but is still receiving more than its share of attention. In the early days of automobiling, engine troubles were frequent, and after being referred to the carbureter or ignition system were eventually diagnosed as due to the oil. This was so because it was the one thing about which the least was known and because the presence of carbon was felt to be a natural result of impurities which caused the dark color present in almost all oils of high flash. Therefore, in order to remove this unfortunate quality, filtration was resorted to and to such an extent that the modern automobile oil is very light in color and hence supposed to be free from carbon. In any oil of reputable make, carbon *always* exists, but chemically. In combustion this may show up as free carbon due to improper combustion or pass off with the products of combustion. Mere filtration does not necessarily make an oil "carbon-proof." Further evidence of this fallacy is the fact that, although lubricating oils in the past few years have been supposed to improve in quality, and hence likely to cause less trouble from carbon deposit, the latter evil has been much more in evidence than ever before. This is caused by a deteriorating quality of *gasoline*, which demands much more accurate carbureter adjustment if proper combustion is to be assured. This is due to the carbon in the gasoline, which by the way exists in it in the same way as in a lubricating oil, i.e., chemically and not free.

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The reason for all this discussion is the fact that filtration beyond a certain point has a detrimental effect on the oil, since it reduces its flash point; and hence should not be carried to the stage where the oil becomes almost colorless. Personal tests have been made with very dark oils of high flash with perfect results as far as carbon deposit, effective lubrication and expense of operation are concerned; in the majority of cases, except when conditions preclude viscosities such as are attendant, such oils are much better lubricants for an automobile engine. (In the foregoing, it is of course assumed that oils from reputable and well-known manufacturers only are being considered.)

VISCOSITY

With reference to viscosity, it must be admitted that this characteristic is open to more legitimate variation than any of the features heretofore mentioned. The viscosity of an oil is an indication of the ability of the oil to maintain itself as a lubricant under severe conditions of speed, pressure and temperature. It is also to a certain extent an indication of the friction of the oil itself; that is, a higher viscosity means a higher internal friction, and vice versa. This may be so definite a quality that the increased friction will develop enough heat to raise the temperature of the oil to a point where the friction would be equal to that offered by the less viscous oil at a lower temperature. Generally speaking, a viscous oil will stand higher temperatures and hence have a higher "factor of safety" for internal combustion engines. The only detriment is that in many installations the customary clearance between piston and cylinder is so small as to preclude the use of any but a very thin oil. This is in reality somewhat unfortunate because in the light of the preceding statements, a thicker oil, i.e., more viscous, would be much more satisfactory for heavy duty, and could be used with complete satisfaction if slightly more clearance existed between piston and cylinder, which would not result in "piston slap" in any greater degree than in the former case. This argument is augmented by the adoption of the latest designs of pistons which are practically proof against scoring and "piston slap."

However, since practice varies so, it is necessary to provide a variation in the specifications for viscosity and this variation should be between the limits of 175 at 70° F, and 150 at 212° F. Tagliabue (approximately.) Below these values the oil is so thin that continued use of it under severe conditions will cause it to break down; above the oil is so thick as to render its lubricating value doubtful until after the engine has been subjected to some minutes of running; in the meantime damage may have resulted.

Preference should be given the heavier-bodied oils since the engine will be more flexible at low throttles and speeds (due to less leakage) and permit of more "abuse" than oils which are on the verge of break-down.

ORIGIN

The last item in this discussion is that of origin. Little need be said in this regard other than the statement that just because an oil was drawn

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from a certain locality does not necessarily prove its superiority over other oils from other parts of the world. It may be true, of course, that nature does not provide oils of the proper characteristics in *all* localities, but this should not be used by manufacturers and dealers in oil to discredit *all* brands except those found in their particular field.

CONCLUSION

In conclusion, a brief résumé will give the following characteristics of an oil best adapted for use in the ordinary form of automobile engine:

Cold Test: Not above 25° F.
Flash Test: Above 400° F.
Fire Test: Immaterial.
Gravity Test: Immaterial.
Color Test: Not necessarily material.
Viscosity Test: Between 175@70° F. and 150@212° F. Tagliabue.
Origin Test: Not necessarily material.

The above characteristics when possessed by most oils of reputable manufacture will insure proper operation under all conditions of loading, speed and temperature, will be proof against use in excessive quantities, will necessitate the least outlay for both oil and repairs to engine; will guarantee flexibility under the most varied conditions, all of which together represent all the demands which can be reasonably made upon a lubricant.

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Ruprecht, Louis, formerly district manager, General Vehicle Co., Inc., Philadelphia, Pa., now with Brady Murray Motor Corp., New York City.

Seeley, S. Ward, formerly associate technical editor, *Automobile Topics*, New York City, now connected with North American Copper Co., New York City.

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Snow, Herbert C., formerly assistant engineer, Willys-Overland Co., Toledo, O., now in engineering dept., Winton Motor Car Co., Cleveland, Ohio.

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123. Production manager or production superintendent. Man who can reduce costs and get out quantities.

127. Salesman for heavy trucks on a commission basis. Not necessary to give entire time.

135. Sales manager, salary and commission to be agreed upon.

140. Assistant to general superintendent. A man thoroughly up on modern production methods.

142. Young man familiar with machine design. Experience on presses and shears preferred. Salary dependent on experience.

147. Sales manager, experienced, on commercial work, and in a position to invest $2,000. Exceptional opportunity.

148. First-class foundry superintendent, familiar with producing automobile castings in gray iron, aluminum and brass, in quantities, with the least possible foundry loss. None but experienced men need apply.

151. Salesman to handle special steels in New England. Must be technically trained and have had practical experience in machining and heat treating of steels.

155. Good man to take charge of assembling and get stuff through in a large business in cyclecars.

156. Experienced draftsman.

158. Draftsmen, with experience in designing small motors or generators for automobiles. For factory manufacturing small interchangeable parts for electrical apparatus. Only those having had at least three to four years' experience need apply. Salary $18 to $22.

159. Designer of successful special machine tools for multiple coincident operations, to design various machines for rapid production of small vehicle parts. Should have factory production experience.

160. Large stable manufacturing company wants man, for sales executive position, whose record warrants immediate assumption of large possibilities; man widely experienced in modern organization and having accurate appreciation of advertising value, as well as broad commercial insight. Experience in the automobile industry is not essential.

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161. Manager for service, parts division and garage of large corporation. Must have excellent engineering and executive ability, besides broad experience in this particular line of work.

163. Practical automobile engineer who has had experience in manufacturing a low-priced automobile and is familiar with costs, etc., and able to equip and manage the factory.

165. Engineer with executive and mechanical engineering ability to take complete charge of truck branch of million dollar concern. Technical graduate preferred. Liberal salary to right man. Exceptional opportunity.

167. Salesman, one that is capable of managing sales department, familiar with the automobile trade and of pleasing personality.

168. Salesmen for electrically-driven tire-pumps for private garage use, on a commission basis.

169. A high-grade retail salesman of moderate-priced pleasure cars for New York City proper.

170. Technical graduate with practical experience in testing laboratory. Must also have some knowledge of electricity and practical experience with motor car work. Salary $150 per month.

171. Checker; must have experience in pleasure car or commercial truck work. Give salary and experience.

172. Tool draftsman. State experience and salary desired.

173. Assistant engineer; must have some shop and at least two years' motor testing and operating experience. Moderate salary, which will be increased as circumstances and conditions might warrant.

174. Engineer or experienced man capable of designing attachment parts for shock absorber.

175. Office manager for office of thirty clerks of an established Massachusetts manufacturing corporation, employing 200 men. Experience needed in accounting, credits, correspondence, purchasing, sales, systems, etc.

MEN AVAILABLE

017. Executive engineer.

025. Consulting engineer can render intermittent service on manufacture or marketing of commercial cars.

026. Engineer of wide experience, designing and consulting.

034. Consulting automobile engineer.

035. Consulting automobile engineer; gasoline or electric work.

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081. Designing engineer, graduate of Massachusetts Institute of Technology, with considerable experimental, factory and designing experience on pleasure cars and trucks. New England preferred.

0180. Competent motor car engineer with five years' experience in both pleasure and commercial car work, is open for engagement as chief, assistant chief, designing or experimental research engineer. Has been connected with the best motor companies and is thoroughly familiar with the manufacturing and production ends of the business. Prefer Detroit or vicinity.

0183. A wellknown consulting engineer in London, England, having representation in America, is open to negotiate manufacturing rights, and to supply all the latest information about European practice.

0196. Graduate mechanical engineer. Has had experience as designer, checker and chief draftsman for past five years with two of the largest companies in this country, making pleasure and commercial vehicles. Wishes position as chief draftsman or assistant engineer.

0198. Position as factory manager or general superintendent.

0200. Designing engineer and purchasing agent. Technical education and eleven years' practical experience in designing and purchasing, pleasure cars, and trucks from 750 pounds to 3 tons. Connected with large concerns in Detroit. Have several up-to-date designs completed to offer. References gladly given.

0201. Engineer capable of managing works, developing carbureting devices for both kerosene and gasoline, and testing generally. Can handle men and get results.

0207. Young engineer with extensive experience in designing, testing and research work on motor trucks. Capable of holding a responsible position.

0210. Young technical graduate with experience in experimental work and drafting desires position in West.

0213. Engineer, experienced in truck and pleasure car design and shop practice, expert designer of special equipment for interchangeable manufacture, open for engagement as superintendent or chief engineer.

0214. Mechanical engineer at present in charge of the designing and engineering end of a well-known truck manufacturing concern desires position as designer, chief draftsman or engineer. Age thirty-four. Eleven years' experience. First-class references.

0217. Member, mechanical engineer, Massachusetts Institute of Technology, now holding position as engineer and factory manager, desires change to position where there are greater opportunities. Fourteen years' experience in automobile industry, successfully

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holding positions as designing engineer of pleasure cars and trucks, and various factory positions up to and including manager of factory employing eighteen hundred men. Have served present employer eleven years. Good executive, with ability to reduce cost of design and manufacture.

0218. Foreign manager—six years with last company. Well-known in automobile trade, American as well as foreign.

0219. Would like to secure agency for approved or desirable specialties, parts or material for introduction to manufacturers. My experience and acquaintance are such as to assure results.

0220. Member with a strong acquaintance and record would like position as sales manager or salesman for first-class line of parts, material or accessories for manufacturers of automobiles or allied products. Has strong personality and been notably successful with lines that require unusual ability to introduce.

0223. A well known sales engineer, who has for eight years successfully handled a prominent imported annular ball bearing, contemplates going into business for himself. Having secured the American agency for a well-known imported ball bearing, and an imported shock absorber of considerable merit, desires to arrange with some one who will furnish capital to the extent of $7,500 cash to be used in defraying the incidental expenses in promoting sales during the first twelve months. Banking connections have been arranged for financing the merchandise accounts.

0228. Shop manager, superintendent or purchasing agent. Young man of thorough business and technical training. Experienced in gasoline motor design, building construction and petroleum refinery work.

0229. Automobile designer, at present assistant chief engineer of a prominent concern desires to make a change. Twelve years' experience in automobile design and construction.

0231. Works manager, active technical man, thirty-seven years of age, designer and producer. Fourteen years' experience making high-grade interchangeable parts, special machinery, ordnance, etc.

0232. Designer of several successful trucks desires position as chief draftsman, assistant engineer or chief engineer with a progressive truck company. Technical graduate. Married. Salary moderate.

0234. Designing engineer connected with one of the most successful Detroit automobile concerns. Twelve years' experience; motor specialist; good executive. Wishes position as chief engineer, assistant chief engineer or designing engineer.

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0235. Engineer with eight years' experience designing and developing automobiles, commercial and cycle motors, desires position as assistant engineer, chief draftsman or designer. Vicinity of New York City preferred.

0237. Position desired as works manager, superintendent or chief inspector. Have handled men for twelve years. Experience covers period of twenty-two years, both large and small machinery, including printing presses, typewriters, conveying machinery and ball, roller and thrust bearings. Experience in organizing and directing inspection departments. At present employed.

0238. Graduate electrical engineer. Nine years with present employer, a well-known pioneer motor truck manufacturer, holding positions as designing and production engineer, factory manager, and branch manager in charge of sales through western New York and Pennsylvania. Able executive.

0239. Sales electrical and mechanical engineer, with some years of civil engineering. Experience in both Europe and this country. Factory management generally. Strongest possible references for executive ability. Strong personality. Available March 1st. Canadian ready to take up duties in any part of world for strong organization.

0240. Position as designer or producer by a practical man. Fourteen years' experience on medium-priced pleasure cars. Location, middle west.

0242. Position wanted as special representative in the Detroit field among automobile manufacturers.

0244. Designing or efficiency engineer for pleasure or heavy truck work. Will not consider light or cyclecar work. Have made a special study for the past three years of cars and their requirements in California and western territory.

0245. Executive engineer or superintendent with nine years' experience in the design and production of gas engines and automobiles. Technical graduate.

0246. Understanding thoroughly all branches of the automobile business, am willing to prove my ability. Nine years' manufacturing experience. Was general manager of one company for seven years.

0247. Technical graduate desires position as assistant engineer or service manager with automobile concern. At present holding responsible position in service department. Purely personal reasons for change.

0248. Assistant to president, general manager or works manager of automobile parts plant. Four and one half years as superintendent of large ordnance and automobile parts plant, employing from eight to twelve hundred hands. Three years general manager of large engineering plant, manager steam turbines and all types of condensing equipment.

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0249. General manager open for an executive position of responsibility in manufacturing lines, which will afford an opportunity for substantial investment later if mutually agreeable. Detroit or vicinity preferred.

0250. Young mechanical engineer, Cornell University graduate, with three years' experience, embracing experimental laboratory and testing, designing and executive positions.

0251. Engineer with exceptional experience in small high-efficiency motors, both fours and sixes. Practical manufacture as well as technical.

0252. Young man with seven years' experience in automobile business in both factory and office end, would like to secure a position with a concern marketing pleasure cars, in either experimental or inspection departments.

0253. Position desired as production engineer or mechanical engineer on manufacturing equipment. Connected seven years with most successful automobile concern in the world. Now connected with leading automobile company. Experience along lines of manufacturing cost reducing. Good executive.

0254. Position in either engineering or testing work. Considerable experience in testing work and design of testing apparatus.

0255. Service engineer, carburetion especially. Twelve years' experience in motor car troubles. Would like position as assistant manager of service department, taking the practical detail work.

0256. Well and favorably known in automobile trade. Last five years sales manager prominent parts manufacturer. American speaking French, German and some Spanish. Prefer connection with good automobile company as export manager and foreign representative or salesmanager of first-class accessory or parts manufacturer.

0257. Draftsman and designer, experienced in design of motor trucks, adding machines, with broad technical education supplemented with shop work, desires a position as designer and engineer in charge of drafting room or engineering department. Have practical experience, able to work out mechanical design. Eight years' experience in automobile and adding machines. Can handle men.

0258. Engineer, capable, energetic, ten years' experience on pleasure, commercial car and electric starter work, desires position as mechanical engineer or chief draftsman. Would like to connect with small live company in which later a financial interest might be taken. Have specialized on efficient running of drafting room, and would consider temporary engagement for systematizing work.

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0259. Motor and chassis designer and checker. Technical graduate with shop experience; specialist on design for quantity production. Have had several months' shop experience with firm building stationary engines, jobbing shop, and with a general manufacturer.

0260. Engineer and producer; ten years' automobile experience as designer, chief engineer and factory manager. Mechanical engineer graduate, thirty-two years old, able and reliable; last position, engineer and factory manager of large plant; connections severed when plant was changed from automobile manufacturing to making of one unit only. Best reference.

0261. Engineer with thirteen years' experience in design and construction of automobiles, trucks; automobile, stationary and marine two-cycle and four-cycle engines for both gasoline and kerosene. Ten years with present employers in large factory. Open for position soon. Manager or engineer in suitable situation desired. Age, 39 years.

0262. Mechanical engineer, eight years' experience in engineering work on light trucks and small cars. Exceptionally good practical experience. Good correspondent and familiar with costs. Capable of handling responsible position. Prefer connection with concern manufacturing product or with parts manufacturer. Have an interesting cyclecar design for any one favoring the new field. Have held present position as chief engineer for past three years.

0263. Designing engineer with broad experience on designing and manufacture of pleasure cars with well-known concerns. Employed at present. Best references.

0264. Factory manager, good organizer and producer with wide experience in engineering and production of both pleasure and commercial cars.

0265. Engineer with eleven years' experience in design and construction of high-class American cars. Specialist in development of high-speed efficiency motors. Authority on carburetion.

0266. Young man experienced as purchasing agent, desires to secure a position with a future.

0267. Service manager whose methods get results and has excellent record, is looking for a greater opportunity.

0268. Mechanical and electrical engineer now employed, experienced in designing, engineering, superintending constructions and productions in quantity, sheet metal specialties and electric vehicles; also gasoline cars. Open for position in New York City or immediate vicinity.

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Vice-president, William Guy Wall, Indianapolis, Indiana.

Vice-president, K. W. Zimmerschied, Detroit, Michigan.

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HERBERT L. CONNELL.....*Secretary and Treasurer*
FERDINAND JEHLE.....*Asst. Secretary and Treasurer*

(Address) 109 Webb Avenue, Detroit, Mich.
Meets first Thursday each month at 8 p. m., in the Employers' Association Rooms, Stevens Building, Detroit, Mich.

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(Address) Wheeler & Schebler, Indianapolis, Ind.
Meets first Tuesday after first Wednesday each month at 8 p. m., at the Hoosier Motor Club in the Claypool Hotel, Indianapolis, Ind.

METROPOLITAN SECTION

JOSEPH A. ANGLADA.....*Chairman*
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(Address) 1790 Broadway, New York City.
Meets last Thursday each month, except July and August, 8 p. m., at the Automobile Club of America, 247 West Fifty-fourth Street, New York City.

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SECRETARY,

SOCIETY OF AUTOMOBILE ENGINEERS,

1790 BROADWAY, NEW YORK CITY.

Please send application blank to

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POSITION AND COMPANY

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whom I consider eligible to S.A.E. membership.

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Date .....

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European Trip Details

S. A. E. BULLETIN

Vol. VI July, 1914 No. 4

PRESIDENTIAL ADDRESS

CONSTITUTIONAL AMENDMENT DISCUSSION

ON PNEUMATIC TIRE RIM STANDARDIZATION

NON-GLARING HEADLIGHTS

STANDARDS COMMITTEE MEETING

DISPOSITION OF STANDARDS COMMITTEE DIVISION REPORTS

SUMMER MEETING ECHOES

Issued to Members
by the

SOCIETY OF
AUTOMOBILE ENGINEERS

1790 Broadway, New York

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S. A. E. Bulletin

VOL. VI JULY, 1914 NO. 4

Published monthly by the Society of Automobile Engineers
1790 Broadway, New York
HENRY M. LELAND, President. COKER F. CLARKSON, Secretary.
HERMANN F. CUNTZ, Treasurer.

Entered as second-class matter, April 9, 1912, at the post office at New York, New York, under the Act of July 16, 1894.

PRESIDENTIAL ADDRESS OF HENRY M. LELAND

Following the custom of my predecessors in the presidency, it is my privilege to address you at this time, touching upon some things that are of interest to all engineers.

Technically, I am not an engineer. No institution has ever given me a diploma. When I started my career in 1858 there were few schools where technical engineering was taught. The technical schools which are now found in almost every city and which for the most part are doing excellent work were unheard of in those days. The State universities where technical engineering is taught have all come into existence since that time, with perhaps two or three exceptions. The help that has been given by these institutions and the advantages which they confer upon the young man who is fortunate enough to avail himself of their instruction can hardly be over-estimated.

What little I know about engineering has come through long training in the workshop, in the manufacture of machinery, and in the part I have been able to take in the development and improvement of the engineering and manufacturing methods which during the last fifty years have been so pronounced. Therefore, in my talk to you today I will, if I may, draw upon conclusions reached through that long and varied experience, rather than from the standpoint of the trained engineer.

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You hear and read so much pertaining to your profession in the meetings of your various organizations, local and national, and in the constant discussions of the unlimited details of automobile construction and engineering, that you will perhaps not be averse to a departure from the routine of your accustomed discussion. With your permission I will discuss the matter from a somewhat different and, in some phases perhaps, a broader outlook than the strictly engineering view usually presents.

It is no reflection upon our engineering society to point out that there is a broader field than is covered by the strictly technical discussions which usually claim our attention. However, before discussing this broader field let me say (and I feel I am not overstating the matter with reference to the importance of the great engineering profession to which you belong) that looking at our great world-wide civilization as a huge and mighty pyramid I believe the engineering profession stands at the very top of that pyramid. In view of the great achievements accomplished by the engineering profession this is a true statement. All the really great achievements which the world enjoys may justly be placed to the credit of the engineering profession, whether we consider the miracle of one of our magnificent steamships sailing up the Hudson or upon the Great Lakes, or one of the great ocean liners passing in sight of our convention hall, with its marvelous equipment, ponderous machinery, boilers, pumps, steering apparatus and everything else required to give speed to the ship, comfort and safety to the passengers and accommodations to carry the commerce of the world; or the mammoth locomotive which we look at with feeling akin to awe, as we see it slowly back up and attach itself to a train of heavily loaded freight cars a quarter of a mile or more in length, and then slowly revolve its wheels and move away with an almost incomprehensible mass of merchandise, constantly increasing its speed until it really flies on its way to the markets of the world.

Or whether we look with wonder and admiration upon the great bridge connecting two great cities like New York and Brooklyn, with its different decks for foot passengers, carriages, automobiles, trucks and street cars. Or whether we consider the tubes under the North or East River, with the myriad boats and ships of all types and sizes sailing above. Or the great subway, burrowing underneath the busy streets while the giant buildings stretch far up into the blue sky above—with its rapidly moving trains propelled by electricity at the speed of a mile a minute, carrying people by the hundreds of thousands in safety to destination. Or whether we consider what is, perhaps, the climax of all recent engineering feats, the great Panama Canal, of difficult, untried and mammoth problems, which have finally been successfully solved.

For each and all these things the world must give credit to

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the engineering profession. To the engineers are we indebted also for the great cables which unite and bring into almost the close intimacy of neighborhoods the continents and islands of the sea. We remember also the telephone and the telegraph, and the mighty forces of electricity in their almost incomprehensible applications; how all these things minister to human needs and comforts. All this and much more is the work of the engineer. Should some man be inspired to write a just and fitting tribute to the engineering profession as a whole he could hardly overstate either the marvels of achievement or the almost incomprehensible advantages and pleasures which we enjoy therethrough. All these have been brought into the life of the people by the engineering profession of the twentieth century.

Nevertheless, great and valuable as have been the achievements of the engineer, I believe there is a larger field which he may occupy if he will. This relates to the engineer rather than to his achievements. To wrest from nature the secrets of matter and forces and to bring order out of chaos is a great satisfaction. To investigate, to contemplate, to labor and bring forth the ideal is the task of the engineer. From the vantage point of my years and my experience, may I suggest to you engineers of a new industry, that in the whole realm of engineering there is no problem so worthy of your skill and ingenuity, and no need so pressing, as that of producing men, not things? No task is so complex and no reward is so great as that which comes to the man who successfully engineers his own life to a higher type of character. In the laboratory of daily life, with the mind, heart and conscience as tools, we should, as engineers of the greatest things, convert our baser tendencies and impulses into the noblest realities.

To every man who has a real earnest desire to make the most of himself (if that is his aim he is an engineer) and to fill to the full the most important niche to which he may aspire, there is a free course and a fair field. It is great to be an engineer. It is greater to be a man—a great, broad, full-measured man. This is the great calling. This is the great engineering feat, and he who would accomplish it must, in all life's great problems, in his dealings with his fellows, in his treatment of those beneath him in rank, in his treatment of the weak and unfortunate, in his walk with his equals and superiors cultivate personal qualities of justice and mercy, fair play and courtesy.

May I express the hope that you men, whose genius and application have in so short a time created from nothing the wonderful automobile industry, will give to the industry such an indelible stamp of personal integrity, uplift and character that our industry shall stand as a type of the highest and best, as it is now the newest. With clean manhood as the starting point, and equipment of theoretical and practical training, we shall be well qualified to enter upon work in life and become successful manu-

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facturers or business men. To be a successful business man is more than to amass large dividends. One may distribute enormous dividends and still be a failure as a business man. On the other hand, "big business" is not criminal or wrong merely because of its bigness. Every red-blooded man will aspire to a position or business so large that it will tax his whole being to master it. I know of no more important or useful member of society than the successful manufacturer or business man who is actually producing, devising or supplying some useful thing; it matters little what, so long as the thing produced fills some real need or want and does not in any way degrade or destroy the best ideals of normal human life. The business man or manufacturer who thus produces materials and is honest and square in all dealings, and fair, just and true to every need and requirement of society, is the most important person, and really does the most for society and the world of any human being.

There is an old saying, "He who makes two blades of grass grow where only one grew before is a benefactor to the human family." I think this statement is just as true of horses, or cows, or sheep. It is just as true of houses and steamships and locomotives, and bridges, of machines, of stores, of factories, and of anything which supplies a legitimate need.

If this be true, may I elevate to the very pinnacle of our pyramid such a business man or such a manufacturer? I am painfully aware that in some places "big business" is unpopular, and that the war-cry of the demagogue, the cheap politician and the sensational press is a blatant and hysterical tirade against successful business. I beg of you not to allow yourselves to be influenced or disturbed by this hysteria. I have been singularly blessed for thirty years with opportunities of mingling with so-called big business men and manufacturers, and I can say to you in all candor and with all the sincerity of which I am capable, that I have found them as a whole (of course, there are some despicable exceptions) the noblest, the most generous, the most honorable and the most just men it has ever been my privilege to meet. I do not except the men of any other calling or profession, whether lawyers, doctors, ministers, college professors, congressmen, senators, or any other class. In all the personal qualities which right-minded men admire, and in activities which make a community prosperous and happy, I have found these big business men superior. I trust you may each be enrolled among them.

Further, notwithstanding popular clamor I can assure you positively that these men of whom I am speaking have done more than all other influences combined to make the American workman the best housed, the best clothed, the best fed and the recipient of the most comforts and luxuries in his home and factory environment of any workman on earth.

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We should not be unmindful of the obligation we owe to the laboring man, or of our dependence upon him, but how fallacious is the notion now being promulgated that labor itself produces all wealth. Some so-called philosophers are even now getting ready to divide all wealth that all men may be on one common financial level. All wealth and all the useful things ever made, or that ever will be made by men in this universe, have been made by labor plus brains, by labor plus will, by labor guided and controlled by experience, training, initiative, and by the persistency of that living, breathing nature by which some men naturally lead and others naturally follow, by which some best plan and others best execute.

Perhaps more closely related to engineering interests is our affiliation as engineers. It was my privilege in 1910 to be entertained, with some of you, by the Institute of Engineers of Great Britain, with a large party of the members of the American Society of Mechanical Engineers. In the summer of 1913 I again had the privilege of going with members of the same society when we were entertained by the German Engineering Society in twelve of the principal cities of Germany. We were most royally entertained, and the trip from the beginning revealed most interesting experiences for a mechanical engineer. One thing that impressed itself very strongly upon me was the greater and better standing which the engineers of both Germany and England seem to have with their governments and communities, as compared with the condition in our country. We were informed repeatedly that whenever the government had in contemplation any great engineering feat, or, in fact, any engineering problem, the authorities having the matter in charge invariably went to the officers of the engineering society and counselled with them in reference to the project and the men whom they should choose to carry out the work.

In many other ways we saw unmistakable evidence of the better standing of the engineering profession in both these countries than we enjoy here in the United States. In casting about for a reason for this it occurred to me that it may be due to the fact that in both these countries all the various kinds of engineers are merged together in one great national engineering organization. I presume that each of the various organizations, such as those of the automobile engineers, the electrical engineers, the mechanical engineers, etc., has its own local divisions for conference and discussion. They are, however, all also interested in the great federation of engineers and meetings of this larger and more important organization are held periodically. This gives far-reaching and important dignity and standing to the profession. I hope that measures will be taken in the not distant future to have all engineering societies in the United States join in a like organization.

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I have been asked to discuss the comparative efficiency of the engineers of either Germany or England and of the United States. I am not prepared to speak finally of this, although I was impressed with the thoroughness and conscientious achievements of the engineers in both the foreign countries mentioned. I believe that the American engineers are as a whole much farther advanced in efficiency and economical achievement than either the German or the English engineers. During our long stay abroad we were asked many times why our manufacturers often secure large contracts which it seemed to the Europeans should naturally go to them, such as for building railroads, or bridges, or for locomotives, in some of their remote colonies or possessions. At one of the largest banquets at which we were the guests we agreed, at their suggestion, to answer this question. Professor Frederick Remsen Hutton, who, as you know, is amply qualified to speak for our industries, explained fully the reason the stated condition prevails. It was briefly this:

By way of illustration, in a certain contract for a bridge to be placed across a chasm in South Africa, those responsible for building the structure had their engineers draw complete detail specifications of the bridge, and forwarded them to the English contractors as well as to the American contractors. The English contractors immediately set about supplying the identical material precisely as specified, making specially each and every piece accordingly. This meant going into their warehouses for the raw material and making up new each piece just as called for.

The American contractors proceeded upon an entirely different basis. They paid very little attention to the details specified, but immediately submitted another plan providing the same length of span and load-carrying capacity as had been specified, but requiring only standard stock material lying all completed in their yards, paying no attention to the peculiar shapes and exact forms and dimensions which had been specified by the engineers in Africa.

Basing estimates on practically standardized parts made in considerable quantities, the Americans were able to quote a very much lower price and several months' quicker delivery of the material, thus securing the order. The people who received the bridge were thoroughly satisfied and pleased with it because it was just as good-looking, just as strong as the one their draftsmen had worked out and entirely adequate in every way.

The illustration goes a long way toward showing the difference in some of the engineering and manufacturing methods employed on the respective sides of the Atlantic. So much for standardization, in which we excel.

The automobile engineers of America have the greatest reason to be proud of the progress and development of their profession in the very few years of its existence. History has nothing to record to compare with it. This progress would not have been

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possible except for the peculiar genius of our trained young men, which enables them to think and act quickly and accurately.

Similarly, the members of the Society of Automobile Engineers have cause to feel pride in their organization, which has so quickly and thoroughly shaped itself into the technical heart and head of the industry. It draws together in personal fellowship all members of the great family. It unitedly solves the problems which none alone could master. To the active officers and to our administrative Council, the Standards and other committees, we are all under lasting obligation for the zeal and fidelity with which they have devoted themselves to our interests. The benefits of the Society have been beyond words. May the future be still richer.

Let me leave you with Conwell's quotation from Bailey.

"Bailey was not one of our greatest writers, but after all, in this he was one of our best:

'We live in deeds, not years; in thoughts, not breaths;
In feelings, not in figures on a dial.
We should count time by heart-throbs.
He most lives
Who thinks most—feels the noblest—acts the best.'"

Gentlemen, if you forget everything else I say, don't forget these two lines; for if you think two thoughts where I think one, you live twice as much as I do in the same length of time.

"He most lives who thinks most.
Feels the noblest—acts the best."

1914 NOMINATING COMMITTEE

The Nominating Committee of the Society is now constituted as follows:

R. H. Combs, Chairman.
H. E. Coffin.
C. W. Spicer.
R. J. Nightingale.
Herbert Chase, Secretary.

Messrs. Coffin, Chase and Nightingale were appointed members of the committee by President Leland, owing to the fact that C. S. Mott, Isaac Kinsey and B. D. Gray, who had been previously appointed, were unable to attend the meeting of the committee held at Cape May last month. The By-Laws of the Society provide that it is the duty of the Nominating Committee to send to the Secretary on or before October first the names of consenting nominees for the elective officers next falling vacant under the Constitution.

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STANDARDS COMMITTEE MEETING

On June 23rd the Standards Committee held a meeting at Cape May for the purpose of considering reports of its Divisions, as approved by the Council. Chairman Henry Souther presided, about forty members of the committee and its Divisions or sub-committees being present. Forty-three other members of the Society also attended.

BALL AND ROLLER BEARINGS DIVISION

The Ball and Roller Bearings Division made a progress report. It was stated that the work of formulating recommendations as to ball bearing practice is virtually finished, and that the Division is giving attention to recommending in what way and to what extent the number of stock sizes of roller bearings can be reduced. A list of 287 sizes used at present was submitted, as well as a list of 47 sizes submitted to the Division as covering all reasonable needs, the latter list having been considered in committee informally only.

BROACHES DIVISION

The seventh report of the Broaches Division, contained in the June BULLETIN, and its supplementary report printed in separate pamphlet form (see page 315, of this BULLETIN), were approved for submission to the Society.*

ELECTRICAL EQUIPMENT DIVISION

The fifth report of the Electrical Equipment Division (printed in the May BULLETIN), recommending temperature test for insulating materials of electrical apparatus on gasoline automobiles, and also the single-wire system with grounded return, was approved.†

The subject of non-glaring headlights was referred to the Electrical Equipment Division for report.

ELECTRIC VEHICLE DIVISION

A progress report of the Electric Vehicle Division was read, telling of the organization and prospective work of the Division.

*Accepted at summer meeting of the Society. See note on page 315.

†Accepted at summer meeting of the Society as to temperature test but not wiring system.

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INDUSTRIAL TRUCKS

Mr. T. V. Buckwalter stated that as a result of experience with industrial trucks he was of the opinion that there is little in common between them and the larger trucks. That there are a number of different features of the former that may properly be standardized. He asked for the appointment of a separate committee to consider the matter.

IRON AND STEEL DIVISION

The fifth report of the Iron and Steel Division, printed in the June BULLETIN, was approved.*

LOCK WASHERS

There was some discussion as to the merits of the S. A. E. lock washer standard, it being argued pro and con that the smallest sizes of the light series were too light. The points raised were referred to the Lock Washer Division for consideration.

MISCELLANEOUS DIVISION

SPARK PLUG SHELL

A progress report was made as to dimensions to be recommended for spark plug shell practice, in addition to the S. A. E. (formerly A. L. A. M.) standard, it being pointed out that the last named does not permit the use of as large porcelain as desired in some cases.

It was announced that the division expected to formulate a recommendation to be made at a later date with regard to the fit of the spark plug shell in the tapped hole.

YOKE AND ROD END PINS

The status arrived at as to recommending dimensions of rod and yoke end pins was outlined.

LICENSE PADS

In the difficult work of recommending practice with regard to a license pad to be used throughout the United States, it developed that the Division was entering into correspondence with the Secretaries of the various States of the Union, with a view to explaining what it is desired to do.

GASOLINE AND OIL SPECIFICATION

The Division expressed the view that gradual progress only can be made in gasoline and oil specification, and that it is doubtful whether practice satisfactory to all concerned can be defined.

*Accepted at summer meeting of Society.

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THREAD PRACTICE IN DIAMETERS GREATER THAN 1½"

A report was given of a canvass made among the members as to proper thread practice in diameters greater than one and one-half inch, the upper limit of the present S. A. E. screw standard. The Division asked for further suggestions in this connection, it being of the opinion that accepted practice would be very beneficial by enabling car makers to buy stock taps and dies.

SPEEDOMETER DRIVE-SHAFT ENDS

The matter of recommending practice as to ends of speedometer drive-shafts was referred to the Miscellaneous Division.

MOTOR TESTING DIVISION

The Motor Testing Division submitted a revised edition of the gasoline motor commercial test forms discussed and accepted, subject to minor correction, at the January, 1914, meeting of the Society. Certain further changes necessary to be made were pointed out. The report distributed at the meeting in separate pamphlet form was approved subject to stated revision.*

PLEASURE CAR WHEELS DIVISION

The second report of the Pleasure Car Wheels Division (printed in the June BULLETIN) was approved.*

RESEARCH DIVISION

The Research Division made a progress report on tests to determine proper tap drill sizes in various materials.

STANDARDS EXCHANGE DIVISION

The Chairman announced that the Council had created the Standards Exchange Division to co-operate with the Automobile Engine Builders' Association.†

*Accepted at the summer meeting of the Society.

†See page 338 of this BULLETIN.

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DISPOSITION OF STANDARDS COMMITTEE DIVISION REPORTS AT SUMMER MEETING OF THE SOCIETY

BROACHES DIVISION

The seventh report of the Broaches Division (June BULLETIN, page 171) and the supplemental report of the Division (see this BULLETIN, page 315), recommending practice for four-spline fittings and castle nut for taper fittings respectively, were accepted.

ELECTRICAL EQUIPMENT DIVISION

The fifth report of the Electrical Equipment Division (May BULLETIN, page 82) was accepted in so far as the recommended temperature test of insulating material is concerned. The recommendation of the single-wire system with grounded return, approved by the Standards Committee and the Council, was not, however, accepted.

IRON AND STEEL DIVISION

The fifth report of the Iron and Steel Division (June BULLETIN, page 162), was accepted.

MOTOR TESTING DIVISION

The report of the Motor Testing Division, recommending final forms for use in the commercial testing of gasoline motors, was accepted.‡

PLEASURE CAR WHEELS DIVISION

The second report of the Pleasure Car Wheels Division (June BULLETIN, page 174), recommending routine test of rims for pneumatic tires, and pneumatic tire sizes for regular equipment, was accepted.

‡Copies of the forms, together with notes for use in connection therewith, will be furnished to the members shortly in the 8½″ x 11″ data sheet size recently authorized by the Council.

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DISCUSSION OF PROPOSED CONSTITUTIONAL AMENDMENT

NOMINATING COMMITTEE

F. E. MOSKOVICS:—Referring to paragraph 50 of the present Constitution, on behalf of Past President Marmon, I present a resolution. He knew the trials and tribulations of the president in appointing various committees, especially the Nominating Committee. There has been considerable discussion among the members of the Society as to the president appointing the Nominating Committee and it has been suggested that other means be employed. The resolution I present would eliminate the words "Nominating Committee" in C 50 and substitute for C 51, which, under the proposed amendment, it is proposed to eliminate, a provision that the Nominating Committee be constituted of seven members, elected annually, each Section of the Society electing one member of the same, and in the event of there being more than seven Sections, the Sections with the largest membership, and in case there are not enough Sections to thus obtain seven members, the members necessary to make up seven being elected at the midsummer business meeting of the Society. It is thought that this would be a more democratic way.

W. G. WALL:—I wish to second the motion which has been presented by Mr. Moskovics. I believe that nothing more important has come before the Society since its inception. As you know, the Constitution now provides for a Nominating Committee to be appointed by the President. In the past we have done very well. Years ago the Society was small and it was very easy to talk over matters of importance. Now, however, it has risen from a mere handful to a great organization, so that it is impossible for us to get together and talk over things as we would like. Cliques are likely to arise, and there will be a certain amount of politics. Of course, politics are not necessarily disadvantageous unless of the wrong kind. Accordingly this amendment has been submitted.

The method suggested in this constitutional amendment might be improved on, but it certainly would provide a great improvement over what we have now. I am very heartily in favor of it.

The Council can, as you know, at any time change the Bylaws and we want the provision made in the Constitution which cannot be changed without the Members' consent; so that the Members can select their own Nominating Committee, which will nominate their officers. Some of you will, of course, say that we have gotten along very nicely in the past. We have, but I tell you this is due very much to the grace of God in giving us such good men for Presidents. The provision of the present Constitution is likely to cause a certain kind of difficulty at any time. Therefore I think we should put through the proposed amendment.

C. E. DAVIS:—The motion appeals to me as logical. The enterprise in which we are all connected as engineers is widespread. At the same time there are concentrated in certain parts of the United States large numbers of men who are vitally interested in this enterprise, and in the

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primary formation of a board of officers they rightfully should have a vote.

It is true, as has been stated, that we have had no difficulty in the past, but as our organization expands it seems to me desirable that the matter of the selection of the officers of the Society should be brought before the different Sections for consideration; that they should have the privilege and it should be incumbent upon them to send men to co-operate in the selection of officers in a way that would induce men of the strongest character to head our Society. I therefore very gladly second the motion.

PRESIDENT LELAND:—Gentlemen, you have heard the remarks. We want to have a free discussion on this matter. Now is the time to talk about it. I hope everybody will speak freely.

R. McA. LLOYD:—I question the advisability of making the change in the Constitution presented here. It is customary in almost all bodies like ours to have a Nominating Committee appointed by the current officers, and if members want to get up another ticket they can do so. Under the Constitution as it is now "Twenty or more members entitled to vote may constitute themselves a special Nominating Committee, with the same power as the annual Nominating Committee." It seems to me that it is going to take up more time and a good deal more trouble to have the Sections and then the Society assembled in summer meeting vote on the membership of the Nominating Committee, with the idea that that is the only way we can get independent nominations. I think that it is always proper for the current officers to put up a ticket; then if others want to put up an opposition ticket there are always means provided for doing so.

W. G. WALL:—A good deal of coercion is required to get members together to put up an opposition ticket. It requires a good deal of red tape, and a ticket put up by the administration always has much more chance of being elected. Therefore I believe we should make the proposed change.

F. E. MOSKOVICS:—Mr. Lloyd has mentioned what is apparently an open course, but it takes considerable courage of the type for which the reward is hardly adequate. It is not so much that there is anything in the past that needs to be corrected as the future. The growth of the society has been so rapid that we are almost like an overgrown child. I believe that the easier the channels through which the Society can express its preference in the matter of officers and the general conduct of the Society are made, the better off we are going to be; the less danger there will be of an administration perpetuating itself. The Society cannot be any stronger than the inclinations of the members. If our ideals are not high we will not be what we should be. The officers should be merely a reflection of the ideals of the members. I feel safe in saying that this is the unanimous opinion of the Indiana Section, which passed a resolution in favor of the substance of the motion I have presented.

H. E. COFFIN:—As a Past President of the Society I have never felt that there was any danger of difficulty or trouble with the Constitution

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as it now stands in the respect under discussion. At the same time I have known that there was a feeling among the members that there was a possibility of danger. If there is a feeling of dissatisfaction on the part of some of the members with the present method of appointment of the Nominating Committee, it certainly cannot do any harm to so change the Constitution as to make the members thereof elective. I am not, however, in favor of doing it in exactly the way pointed out by the motion under discussion. I would like to ask what percentage of our membership is enrolled in the Sections at the present time. Certainly not half.

SECRETARY CLARKSON:—No, much less than half.

H. E. COFFIN:—We see immediately that in placing the power of election of officers in the hands of the Sections we would exclude at once perhaps three-fourths of our membership from any voice in their choice. All of us certainly want to avoid politics within the organization. We do not want two tickets in the field. It is all very well to say we can get up an additional ticket if we do not like the one chosen. As soon as we start that, we are going to introduce a lot of bad feeling, or be very apt to at least. We have been entirely free from that sort of thing in the past. If there is a feeling, as there apparently is, among the members that the old method of appointment of the Nominating Committee should be changed, it should be changed. But I believe we should not adopt the way that has been suggested.

F. E. MOSKOVICS:—There are at the present time only three Sections. Four members of the committee would be elected by the Society. With seven Sections in the Society the chances are that they would represent the majority. It seems to me that the election of officers should be in the hands of the men who take enough interest in the Society to attend its deliberations.

DAVID BEECROFT:—I am in favor of having the Nominating Committee enlarged. If it were an elective body all Members should have a free voice in the matter. With a committee of seven it would be wrong to have all seven elected by the Sections, which would exclude all individual members from voting directly. I believe that if our committee consist of seven, never more than four should be representatives of the Sections, and that those four should come from the Sections having the largest membership. There should never be fewer than three members of the committee elected by the Society at its summer meeting.

F. E. MOSKOVICS:—I can see no objection to accepting that as an amendment to my motion.

W. G. WALL:—I accept the amendment.

DAVID BEECROFT:—It has been suggested that it would be better than having four members elected by the Sections, to have three elected by the Sections and four by the Membership at large at the summer or semi-annual meeting of the Society; the three members elected by the Sections to be elected prior to the time of the semi-annual meeting of the Society. I change my suggestion to that effect.

PRESIDENT LELAND:—Does that meet with your approval, Mr. Moskovics?

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F. E. MOSKOVICS:—Yes, I will accept that amendment.

W. G. WALL:—It is satisfactory to me also.

PRESIDENT LELAND:—You have heard the motion as seconded and amended. Is there any further discussion? If not, are you ready for the question?

(The motion was put to a vote and carried unanimously.)

JUNIOR GRADE OF MEMBERSHIP

H. C. WILSON:—I move that the phraseology of C 10 be changed to read as follows:

"Junior grade shall be composed of persons who at the time of election are under twenty-six years of age, and qualified to fill subordinate engineering positions in the automobile or allied industries, or who are regularly enrolled students at or graduates of a technical school. A junior member may upon reaching the age of twenty-six and shall upon reaching the age of thirty be transferred to Member or Associate grade in accordance with the decision of the Council as to which grade his qualifications entitle him."

This would permit a Junior to remain at his option a Junior until the age of thirty, at which time he would become a Member or Associate.

(The motion was seconded.)

H. E. COFFIN:—I would like to know the reason of the suggested change.

H. C. WILSON:—The Council has had requests from Juniors who have reached the age of twenty-six that they be not transferred to Member grade. In some cases they have not been prepared to assume additional financial obligation. Furthermore, the proposed change is in accordance with the procedure of practically all the other engineering societies. It would make it easier for a man to obtain standing in the Society, without putting a burden of about $10 a year more on him. We have a great many young men in the Society who have not reached a point at the age of twenty-six where they feel they want to assume that obligation.

H. L. CONNELL:—In the present tendency to raise the standards of the Society would it not be well also to give the Council power to keep a Junior a Junior until thirty? At twenty-six a Junior may not have reached the engineering standard entitling him to become a Member.

H. C. WILSON:—We wish to make it possible for a Junior who is qualified, when he passes the age of twenty-six, to go into Member grade (something for him to look forward to), but not to make it obligatory upon him to either assume this grade of membership or else be compelled to withdraw from the Society. The Council has no other alternative at present.

PRESIDENT LELAND:—Is there any further discussion, gentlemen? You have all heard the discussion of the motion made by Major Wilson. Are you ready for the question? All those in favor of the motion made by Mr. Wilson say "aye"; contrary "no." It is carried.

Are there other amendments, gentlemen?

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STUDENT ENROLLMENT

W. G. WALL:—I offer this amendment.

Add to C 56 the following:

"The Council may further in its discretion authorize the enrollment, individually or by group, of persons under thirty years of age, who at the time of application shall be bona fide students at a recognized institution of engineering or pursuing a course of study in automobile engineering. Student enrollment shall be for the term of two years, which may upon application be extended by the Council for an additional two years. Enrolled students shall not be Members of the Society, or be entitled to vote or hold office."

The motion is also to add to C 22, under "Initiation Fees," "Student Enrollment, none."

Add to C 23 (Annual Dues), "Student Enrollment, $3."

It is proposed to have provided in the Bylaws that each applicant for student enrollment shall be endorsed by a member of the Society and approved by the Council. That enrolled students shall receive the regular monthly publication and may attend the meetings of the Society. That student enrollment shall be revocable at the pleasure of the Council.

PRESIDENT LELAND:—Gentlemen, you have heard the amendment moved by Mr. Wall.

A. B. CUMNER:—I second the motion.

H. E. COFFIN:—Why not make the term three years and have the term not renewable? It is not likely that a student in college would care to enroll for more than three years. It seems to me that it would be simply making work for the Council to have a term of enrollment run two years and be renewable for an additional term.

W. G. WALL:—I can see considerable logic in what Mr. Coffin has just said. I think that there is no great advantage in having the enrollment for two years and that probably it would be better to have it for three years, and not renewable.

PRESIDENT LELAND:—Do you accept Mr. Coffin's suggestion as an amendment to your motion?

W. C. WALL:—Yes.

PRESIDENT LELAND:—Is the seconder willing to so accept it?

A. B. CUMNER:—I am.

W. T. NORTON, JR.:—I would like to ask whether enrolled students would be entitled to the Data Sheets and the general information published at present.

SECRETARY CLARKSON:—No, the monthly Bulletin only and not the Transactions or Data Sheets.

DAVID BEECROFT:—Where would the line be drawn in deciding who shall be enrolled as a student?

H. C. WILSON:—Apparently there is no line drawn. If a man states that he is studying a book at night, he is pursuing a course in automobile engineering. The enrollment would be within the discretion of the Council.

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C. E. DAVIS:—Would that not be governed automatically by the substance of the application presented?

H. C. WILSON:—It seems that the only control we would have is the endorsement of a member of the Society. The object is to afford all the educational advantage we can to the youngster; hence, on account of the need of something of the kind, we must depend largely upon the knowledge and endorsement of the man proposing him for enrollment.

PRESIDENT LELAND:—The enrolled students would be in no sense members. The purpose is simply to give them some assistance. Is there any further discussion?

JOHN O. HEINZE:—If the Society desires to assist students, it is perfectly possible for it to sell them its literature.

H. C. WILSON:—We would have missionary or recruiting ground in addition to helping those men who are interested in automobile work. We are not seeking profit out of the enrollment. The purpose is to assist young men who are interested.

DAVID BEECROFT:—This student enrollment is an excellent thing. I am heartily in favor of it. It will be of practical benefit to the Society. It will serve as a good feeder for membership at a very nominal expense to the Society. It will help in a lot of the work and activities the Sections have to carry on. I think it will be very valuable. The I. A. E. of England has a student membership which last year was very active. They had certain sessions of their own at which they took up problems having a direct bearing on the work of the parent society. A student membership could carry on the same work in this country.

W. H. CONANT:—I think that perhaps the best answer to one of the last speakers is to be found in the proposed C 2 of the Constitution: "The object of the Society is to promote the Arts and Sciences and Standards and Engineering Practices connected with the design and construction of automobiles." Further this paragraph reads: "The principal means for this purpose shall be the holding of meetings for the reading and discussion of professional papers and reports." The Society must depend upon young blood for the very near future.

PRESIDENT LELAND:—Are you ready for the question?

(The question was called for.)

You have heard the motion made by Mr. Wall and seconded and amended. It has been carefully and thoroughly discussed. All those in favor of the motion manifest it by saying "aye"; contrary "no." The motion is carried.

Amendment as Amended Approved

HENRY SOUTHER:—Mr. President, the whole amendment as printed in pamphlet form and distributed at this and the last meeting of this Society, has been very carefully prepared by a competent committee. I would like to move that it be accepted as printed and amended at this meeting.

(The motion was seconded by E. S. Foljambe.)

PRESIDENT LELAND:—Is there any discussion of Mr. Souther's mo-

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tion? Are you ready for the question?

(The question was called for.)

All those in favor of the motion made by Mr. Souther will manifest it by saying "aye"; contrary "no."

The motion is carried.

CLEVELAND SECTION ORGANIZED

At an organization meeting held by members of the Society resident in Cleveland and vicinity, a committee of five, consisting of R. J. Nightingale, Christian Girl, A. J. Scaife, J. H. Hertner and W. R. Strickland, was appointed to arrange a time and place of meeting to recommend a list of officers for the newly organized Cleveland Section. At the last mentioned meeting the following officers were nominated:

James H. Herron.....Chairman
H. B. Anderson.....Vice-Chairman
A. J. Scaife.....Treasurer
R. J. Nightingale.....Secretary
E. R. Hall...
J. H. Hertner.}.....Board of Directors
R. H. Manson

The Cleveland Section was represented at the conference held at Cape May between officers of the Sections of the Society and the Advisory Committee appointed by the Council, which appreciates thoroughly the value of the work of the Sections and the importance of increasing the scope of the activities of the same.

PRESENTATION TO S. A. E. BY MEMBERS OF I. A. E. AND S. M. M. T.

At the time of the summer meeting a most pleasant reminder of the visit of our British cousins to this country last year was received in the form of a charming memento and very beautiful as well as useful reading desk, presented by members of the Institution of Automobile Engineers and of the Society of Motor Manufacturers and Traders. These will serve admirably at the rooms and meetings of the Society as a concrete embodiment of the cherished remembrances of the visit. A rising vote of thanks in grateful acknowledgment of the gift was passed and hearty greetings extended to the officers and members of the I. A. E. and S. M. M. T.

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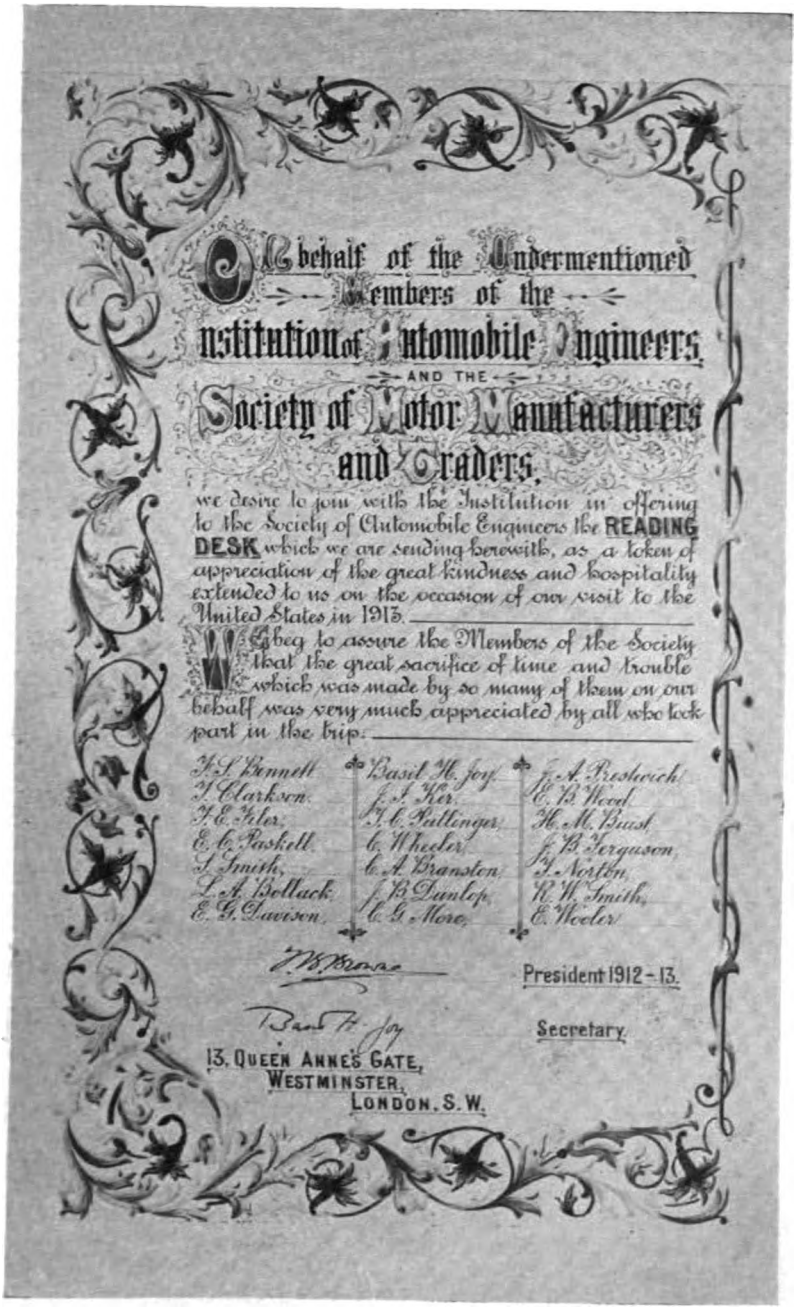

On behalf of the Undermentioned Members of the

Institution of Automobile Engineers

AND THE

Society of Motor Manufacturers and Traders,

we desire to join with the Institution in offering to the Society of Automobile Engineers the READING DESK which we are sending herewith, as a token of appreciation of the great kindness and hospitality extended to us on the occasion of our visit to the United States in 1913.

We beg to assure the Members of the Society that the great sacrifice of time and trouble which was made by so many of them on our behalf was very much appreciated by all who took part in the trip.

F. S. Bennett	Basil H. Joy	J. A. Prestwich
J. Clarkson	J. A. Ker	C. B. Wood
F. E. Ihler	J. C. Pallenger	H. M. Bunt
E. G. Paskell	G. Wheeler	J. B. Ferguson
J. Smith	C. A. Branston	J. Norton
L. A. Bellack	J. B. Dunlop	R. W. Smith
E. G. Davison	C. G. More	E. Wooler

W. M. Bruce — President 1912-13.

Basil H. Joy — Secretary.

13, Queen Anne's Gate,
Westminster,
London, S.W.

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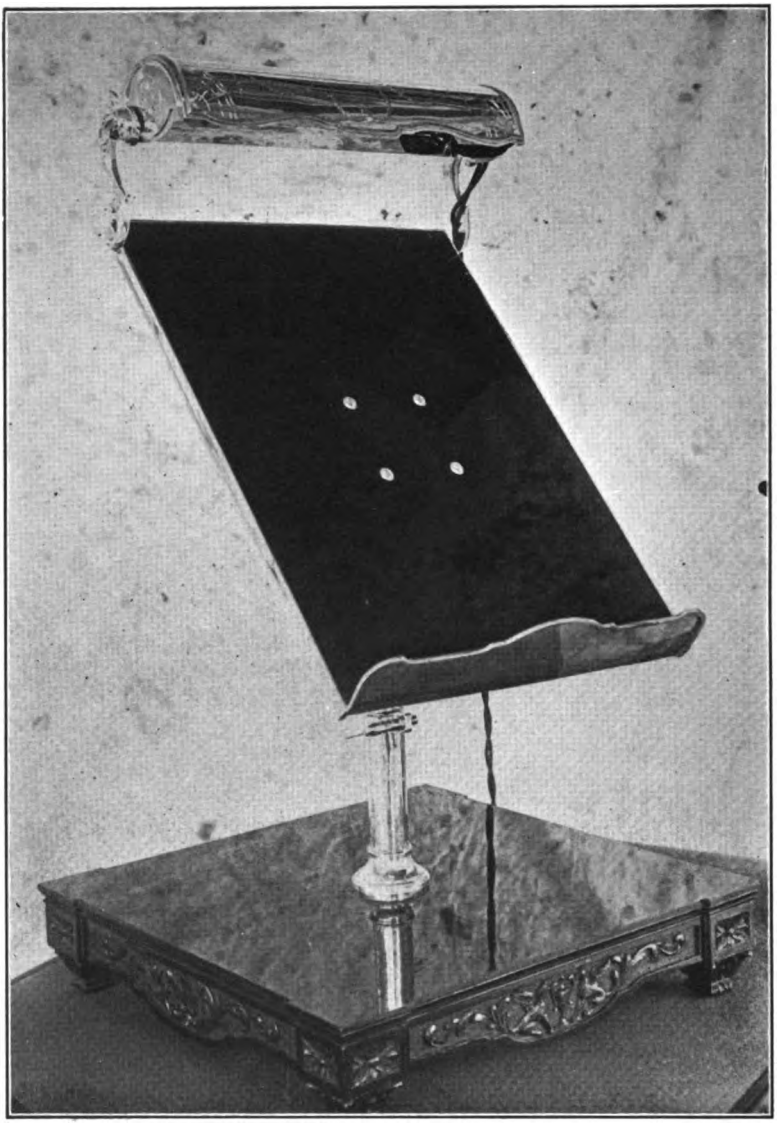

Reading Desk Presented by Members of the I. A. E. and S. M. M. T.

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EUROPEAN TRIP

The General Committee on Arrangements desires to obtain from all members of the Society an expression of intention as to taking part in the European trip planned for this fall. In order that you may consider the question intelligently the itinerary tentatively determined on is given herewith.

In setting the date for departure consideration had to be given to the opening dates of the Paris Salon and the Olympia Show in London. The Paris Show opens on the 16th of October and the Olympia Show on the 6th of November. A study of the steamship schedule did not reveal a regular sailing date of a fast ship arriving in time for the opening of the Paris Salon, but after negotiations the North German Lloyd Steamship Company agreed to advance the sailing date of the Kaiser Wilhelm II to October 9th at 1.00 a. m. Weather permitting, the vessel will arrive at Cherbourg in time to enable the S. A. E. party to reach Paris on the afternoon of Thursday, October 15th.

PARIS

The stay in Paris extends from Thursday, the 15th, to Wednesday, the 21st of October. Headquarters will be at the Hotel Edward VII, which is located in the heart of the city. The plants available for inspection in Paris are those of the Alda, Aries, Bedelia, Brasier, Briscoe, Clement-Bayard, Charron, Delage, Darracq, Delahaye, DeDion-Bouton, Delaunay-Belleville, Doriot-Flandrin-Parant, Gobron, Gregoire, Henri Labourdette, Hotchkiss, Lemoine, LaLicorne, Lorraine-Dietrich, Panhard et Levassor, Renault Frères, Saurer, Turcat-Mery, Unic, and Vinot

It is obvious that all of these plants cannot be visited by the party as a whole; consequently selections must be made by the individuals as to which they most desire to see and parties made up accordingly. Arrangements will probably be made for season passes to the Paris Salon for our members.

For those desiring to go sightseeing in Paris the following itineraries for three days' excursions can be arranged:

(In the City) (MORNING)

Leaving the heart of Paris, Place de l'Opera, the Grand Boulevards are traversed for three miles, passing the old city gates, Porte St. Denis and Porte St. Martin, to the great Place de la Republique, with its statue, and the Place de la Bastille, where the Column of July marks the site of the old prison, to the ancient Place des Vosges, former quarter of the aristocrats, where are the houses of Victor Hugo and Madame de Sevigne; past the Church of St. Paul and the college Lycee Charlemagne; crossing the quiet Ile St. Louis to the Ile de la Citè, the original Paris, where

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Notre Dame Cathedral is visited. Close by, enclosed in the immense Palais de Justice, or court-house, is the beautiful Sainte Chapelle, built by St. Louis, and having fine Gothic colored windows. The first town clock in France is still seen on the side of the Palais de Justice in going to the Chatelet, on which fronts Sarah Bernhardt's Theatre. The fine Tour St. Jacques, remnant of a church, stands in a little square and the City Hall, or Hotel de Ville, presents its imposing facade, its interior having fine modern art decorations. From here (except on Mondays) the Louvre Museum is reached and visited. When the Museum is closed the drive will be to the great markets (Les Halles), the Place des Victories, with its fine church and statue of Louis XIV, and the Bourse, or Stock Exchange, before returning to the Place de l'Opera or the hotel for luncheon.

(AFTERNOON)

The afternoon drive will again start along the Grand Boulevards but westward, passing the church of Madeleine, the Rue Royale to the great Place de la Concorde, with its Obelisk where the guillotine once stood; over the Seine by the Pont de la Concorde to the Palais Bourbon, or Chamber of Deputies, the Ministry of Foreign Affairs, the Invalides, with the Tomb of Napoleon, the Champ de Mars, site of several expositions, the Eiffel Tower; back over the Seine to the fine Gardens and Palaces of the Trocadero, with various museums; through aristocratic residence streets to the Arch of Triumph at the Place de l'Etoile, back down the park-bordered Avenue of the Champs Elysées to the Grand and Petit Palais, built for the exposition of 1900 and now used as museums; past the Place de la Concorde and the end of the Tuileries Gardens, to the Place Vendome, with its Column, along the Rue de la Paix, of dressmaker and jeweler fame, to the Opera.

(In the City) (MORNING)

Starting northward from the center of the city the fashionable church of St. Augustine is passed, and the beautiful little Park Monceau is crossed, viewing its statutes and artificial Greek ruins, to the Arch of Triumph. Out the great avenues that continue to the Champs Elysées, the Bois de Boulogne is reached. In crossing it the Lakes and Grande Cascade are seen and the race course of Longchamp passed. The citadel on Mont Valerien, once the site of the Prussian batteries, is seen above the pretty town of St. Cloud, which is traversed to higher quarters at Montretout, and then, amidst villages and fine forests, the road leads past Ville d'Avray, whose lake was Corot's favorite subject. By the Avenue de Picardie, Versailles is reached, favorite home of French royalty. Here is the grand Park, the small palaces of Grand and Petit Trianons, with private apartments and furniture of Napoleon I., Empress Josephine, Madame de Maintenon and various royal personages are visited, and some interesting state carriages are seen.

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(AFTERNOON)

After luncheon the immense galleries of paintings in the Palace will be visited, and the fountains, arbors and many attractions of its famous park enjoyed. The drive back to the city will be by a more southern route, on the Avenue de Paris, past Viroflay, Chaville, Sevres, with its State porcelain factory, Billancourt, through the fortifications at Auteuil, near its great viaduct, past the Palace of the Trocadero and Eiffel Tower, along the Seine Embankment, and the Cours la Reine, with some interesting houses, to the Place de la Concorde and the hotel.

(To Versailles)

The Royal Palace and Gardens of Versailles, a dozen miles from Paris, are among the most extensive in Europe. The Palace is filled with historical paintings and mementos of the former royal occupants. The Grand and Petit Trianons give even more intimate details, for all the old furniture is on view. Numberless fountains adorn the great park and the Swiss Village where the court played at rustic life is very attractive.

From Paris, commencing at time of departure and up to the time of the arrival in London on Thursday, November 6th, the transportation and hotel arrangements of the trip will be in the hands of Thomas Cook & Son. The arrangement made by the Society with this firm stipulates a fixed rate of $150 per person, including all railroad and steamship transportation from Paris to London, sleeping car and steamer stateroom accommodations, transfer of passengers to and from hotels and railway stations, transportation and caring for baggage, meals on dining cars when the train schedule includes traveling during meal hours, accommodation at first-class hotels (except in Paris and London, where the members will secure their own quarters), such accommodation to include lodging, meat breakfast and all service tips. It was thought best not to include luncheons or dinners in these arrangements, as it is likely that a good many luncheons will be taken either at factories or nearby, and that the members would prefer to "take in" typical local restaurants for dinner.

TURIN

On Wednesday, the 21st, we will leave Paris at 2.20 p. m., arriving at Turin, Italy, the next morning. Plants available in Turin are those of the Aquila, FIAT, Diatto-Clement, Itala, Lancia, Lux, Nazarro, R. I. V., Scat, and S. P. A.

Turin the former capital of the Kingdom of Sardinia, and from 1860 to 1865 the capital of the Kingdom of Italy, is a most regularly built city.

The Palazzo Madama (erected near the end of 13 cent.—the name refers to Maria, mother of Vittorio Amadeo II. early in 18 cent.), in the middle of Piazza Castello, is the only remaining mediæval structure

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in Turin. On the north side of the Piazza is the Palazzo Reale, a brick building dating from 1646; royal apartments shown daily. In the southeast wing of the Palace is the Armeria Reale (Royal Armoury); interesting collection of armour, weapons, flags, Napoleonic relics, etc. The Royal Library of 70,000 vols. and 3,000 MSS. is in the same building below. On the west side of Palazzo Reale is the Catterrale (San Giovanni Battista) in the Renaissance style, 1492-1498. The Pinacoteca (Picture Gallery) is in the Palazzo dell' Accademia delle Scienze, on the south side of the Piazza Carignano, which runs out of Piazza Castello near southeast corner. The Museo Civico is in Via di Gaudenzio Ferrari; collection of modern pictures, sculpture, enamels, pottery, ivories, stained glass. Among the churches worth attention are the Church of La Consolata in Via della Consolata, a little northwest Piazza Castello; a much venerated Madonna in this church of Gran Madre di Dio, over the bridge at the south end of Via di Po. Church of Corpus Domini, a little southwest of the Cattedrale. Paizzo di Citta (Town Hall) contains a library; several statues. University, in the Via di Po, running south from Piazza Castello; about 2,500 students.

MILAN

We leave Turin at 8.00 p. m. the same day (the 22nd), arriving in Milan at 10.50 in the evening, where a stay will be made until Sunday morning, the 25th. In Milan are located the following plants, available for inspection: Alfa, Bianchi, Isotta-Fraschini and Serpollet.

Although an important city so long ago as the Roman period, Milan has been so many times destroyed as to be practically a modern city. It is Italy's greatest manufacturing center, and second city in population. Milan's chief glory is the marvelous Cathedral, founded in 1386, the third largest church in Europe, an edifice of singular majesty and beauty. It is covered entirely with white marble, and the wonderful roof is adorned with more than 2,000 statues, and 98 turrets, all of marble. From the tower 360 feet high and reached by 500 steps, the roof, with its glistening tracery, pinnacles, spires, statues and flying buttresses, presents a glorious spectacle. The interior is vast and impressive, with the largest stained-glass window in the world. Next the church of S. Maria delle Grazie is the refectory of the old Dominican Monastery, containing Leonardo da Vinci's famous fresco of the "Last Supper," much dilapidated. The Brera, or place of arts and sciences, was formerly a Jesuit college. It contains the National Library and a picture gallery with a number of masterpieces. The Church of St. Ambrogio and the house of Verdi may be visited.

LUCERNE

Leaving Milan at 7.25 a. m. on Sunday, the 25th, the party is due to arrive in Lucerne, Switzerland, at 1.51 p. m. the same afternoon, remaining there until Tuesday morning, the 27th. While there are no plants of any particular interest to be seen in

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Lucerne, it has been thought best to incorporate a break in the trip to allow a slight amount of rest and recreation.

With its ancient walls and watch-towers Lucerne is one of the most picturesque cities of Switzerland. Its lovely situation on the Lake of Lucerne, in full view of the Rigi, Mount Pilatus and many snow-clad Alpine peaks, and accessibility among the grandest scenery of the Alps, make it an important travel center. Among the attractions are Thorwaldsen's Colossal Lion, sculptured from the natural rock in memory of the Swiss Guards killed in defending the Tuileries in 1792; the two curious mediæval wooden bridges over the River Reuss, each containing many quaint old paintings on panels in the roof; the old church of St. Leodegar, with a noted organ; the Glacier Garden, a relic of the glacial epoch, and some curious old houses. The Gutsch is a wooded height about 2,000 feet, ascended by cable cars, from which a marvelous view of the town, lake and mountains is obtained. Mount Pilatus can also be ascended by railway, and gives a view much resembling that from the Rigi, described below.

The Lake of Lucerne

Or Lake of the Four Forest Cantons, is the most beautiful of Swiss Lakes, surrounded by scenery of singular magnificence and grandeur. Great historic interest centers here, for the shores are associated with many stirring incidents in the heroic struggle for Swiss independence, and with the traditions of William Tell. Its pellucid waters, varying prospects of mighty Alpine peaks, wooded hills, lovely villages and villas, gardens and pastures, its poetic legends and associations give it an abiding charm. The ascent of the Rigi, 5,905 feet, accomplished in about one hour and a quarter by mountain railway, is one of the most celebrated excursions in Switzerland, and reveals a prospect that for grandeur and beauty and vast extent is unsurpassed in the world. The Rigi Kulm, or summit, may be reached by rail from either Vitznau, a favorite resort on Lake Lucerne, or from Arth, a pretty village on Lake Zug, this line also connecting at Goldau with the St. Gothard Railway. By either route the ascent traverses scenes of the wildest beauty—forest, rocks, torrents—through tunnels and around precipices, the view constantly growing more extensive. From the summit a superb panorama some four hundred miles in circuit is revealed, embracing the chain of snow-clad Bernese Alps, many lakes, cities and villages, reaching as far as the Jura and Vosges Mountain, and the Black Forest.

NEUHAUSEN

Leaving Lucerne at 9.14 a. m. on Tuesday, the 27th, we will arrive at Neuhausen at 12.56 p. m. and devote the afternoon to a visit to the Fisher Electric Forge Works at Schauffhausen, just across the river.

A magnificent view of the Falls of the Rhine is obtained with the Castle of Laufen on the rock promontory round which they swirl, and

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that of Wörth, just across beyond the bend. The glorious color of the river, its foliaged banks, and the sweeping distance, make up a panorama of rare beauty.

STUTTGART

Leaving Neuhausen at 9.37 on the morning of Wednesday, the 28th, Stuttgart will be reached at 2.03 p. m. for a stay until Friday, the 30th. At Stuttgart visits can be made to Robert Bosch, Daimler Motor Company, Eisemann, Ernest & Company, Mea Magneto Company, Norma Company.

Stuttgart is the capital of the Kingdom of Wurtemberg. The modern section is handsome and the old parts have retained many of their picturesque features.

Adjoining the Schloss Platz is the Royal Residenz Schloss, erected 1746 to 1807, in French Renaissance style; the finest parts of the interior are the stairs, with painted ceiling, and the marble salon, frescoes, pictures and statues in the salons—in all there are 365 rooms. The Altes Schloss of the 16 cent., on the southwest side of the Schloss Platz, is used as Government offices. Immediately west of Altes Schloss is the Stiftskirche (Evangelical), dating from 1436, restored 1895; fine stained glass, statues of Counts of Wurtemberg. Across the open space from the Altes Schloss is the Prinzenbau, erected 1694-1710, a royal residence. The Konigsbau, a graceful colonnaded building, erected 1857-1860 on north side of the Schloss Platz, has on the upper floor a very handsome concert hall. At the side of the Konigsbau is the Kronprinzenpalast. At east side of Schloss Platz is the Queen Olga Palace. The Akademie, where is the Royal Library, is immediately behind the Residenz Schloss; in the east wing of the building are the royal stables.

MAYENCE

Friday morning, the 30th, at 10.03 a. m. we leave for Mayence, arriving at 2.51 p. m.

An historic city on the Rhine, once a great Roman stronghold, Mayence is not a heavily garrisoned modern fortress. In the citadel is the celebrated Tower of Drusus, said to have been built by the Romans, 9 B. C. The Cathedral is one of the finest in Germany, with many interesting monuments, and St. Stephen's Church, a thirteenth century edifice, on a considerable eminence, affords a magnificent view from the tower. Thorwaldsen's imposing statue of Gutenberg (the famous printer who was born at Mayence) is one of the sights of the city. There are usually excellent concerts in the evening in the Stadthalle.

A short trip can be made to Frankfort, the location of the Adler and Opel plants.

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COLOGNE

Saturday, the 31st, will be devoted to a steamer trip down the Rhine, leaving Mayence at 10.00 a. m. and arriving in Cologne at 7.30 p. m. of the same day.

A picturesque old city on the Rhine, Cologne has been a place of importance since Roman times, and still contains many important mediæval buildings and remains. Its chief attractiton is the superb Cathedral, the most magnificent Gothic edifice in the world. Begun in 1248, it was not completed until 1880. The towers are 500 feet high, the highest of the kind in the world. The Treasury contains much beautiful gold and silver work, and many relics, including the alleged skulls of the Three Wise Men of the East. Cologne has some interesting churches, among them that of St. Ursula, decorated with the bones of St. Ursula and her 11,000 virgins, and St. Gereon, containing the skulls of the 6,000 martyrs of the Theban Legion. The old Rathhaus, with the fifteenth century Hanseatic Hall, is a unique building, and adjoining is an extensive museum. There are numberless shops for the sale of the famous perfume, Eau de Cologne. The Ring Strasse is one of the most charming series of boulevards in Europe. During the summer of 1914 an industrial Exposition will be open in Cologne, illustrating international mechanical progress.

Headquarters will be made in Cologne from the evening of the 31st until the morning of the 3rd.

On Monday, November 2nd, a trip to Essen, about ninety minutes by train, is scheduled, for a visit to the famous Krupp Works, returning to Cologne about a quarter of seven in the evening.

BRUSSELS

On Tuesday, the 3rd, we will leave Cologne at 7.56 a. m., arriving in Brussels at 11.25 a. m. In Brussels are located the following plants: Pipe, F. I. F., and Germain, all of which are available for visits. The schedule calls for a stay in Brussels until Thursday, the 5th, but it is thought that some will desire to visit Dusseldorf, going there from Cologne, delaying the arrival in Brussels by one day. This can, however, be settled by agreement.

Brussels, the gay and handsome capital of Belgium and residence of the royal family, has been well called "Paris in Miniature." It is a city of imposing boulevards, spacious parks and handsome streets, lined with magnificent buildings, both mediæval and modern. Its shops rival those of Paris in attractiveness. In the quaint old Grand Place are the noble Hotel de Villa, begun in 1402, the Mansion du Roi, 1514, and the ancient Guild Houses. The Cathedral of St. Gudule, founded in 1220, contains some celebrated stained glass, pictures, and old wood carving. The great Palais de Justice is one of the largest and most magnificent public edifices

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in the world. The House of Representatives, or the Palais de la Nation, is also imposing. There are several interesting old churches. The Picture Gallery has the finest collection in Belgium. The Wiertz Museum is filled with pictures of weird and striking character. Brussels is famous for its lace, and a visit to a lace factory is an interesting experience. The Bois de la Cambre, a beautiful park, is the most frequented promenade in Brussels. And if time permits, every one will, of course, make an excursion to the historic battlefield of Waterloo.

ANTWERP

Leaving Brussels at 8.52 a. m. on Thursday, the 5th, Antwerp will be reached at 9.48, the rest of the day being devoted to a visit to the Minerva Company.

One of the most important of European seaports, Antwerp is full of interest. Its ancient streets, its busy markets with their motley crowds, its great old-fashioned, lofty gabled, quaint looking houses, its statues, fountains, public buildings and fine new boulevards, are all attractive, often by contrast of the new and old. Then there are the magnificent quays and docks crowded with the shipping of all nations, and easily viewed from elevated "promenoirs," or viaduct. A notable feature of Antwerp street life is the use of dogs for drawing small vehicles. The Cathedral, which dates from 1352, has an exquisitely sculptured spire, one of the loftiest in the world (404 feet), and a carillon of 40 bells. The cathedral contains among other treasures the world-famed masterpieces of Rubens, the "Descent from the Cross" and the "Elevation of the Cross," and some splendid wood carvings. Outside the cathedral is an old well with a wrought-iron canopy by Quentin Matsys, the blacksmith painter. The Stein Museum, formerly a prison of the Inquisition, and the Plantin Museum, former residence of the famous printer, are interesting. The principal churches, St. Paul, St. Andrew and St. Jacques, possess many celebrated paintings, and in the last named is the tomb of Rubens. Outside the Church of St. Paul is a strange rock-work Calvary.

LONDON

The steamer for London via Harwich leaves Antwerp at 7.00 p. m., arriving the next morning in Harwich in time to reach London at 8.00 a. m. In London the headquarters of the party will be at the Savoy Hotel, until Sunday, the 15th. During the stay in London the members will be in the hands of our good friends of the I. A. E. Their tentative official program for the entertainment of the party is as follows:

Friday, November 6th.—Olympia Show. Banquet in the evening.

Saturday, November 7th.—(Morning) Vauxhall Works or Commer Cars, Luton. Afternoon, Show.

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Sunday, November 8th.—Hendon Aerodrome.

Monday, November, 9th.—Wolseley Works, Birmingham.

Tuesday, November 10th.—Alternative visit to Daimler Works, Coventry, or Austin Works, Birmingham.

Wednesday, November 11th.—Olympia Show, with alternative visit to National Physical Laboratory, Teddington, in the afternoon. Meeting and paper in the evening.

Thursday, November 12th.—Visit Rolls Royce, Ltd., Works, Derby.

Friday, November 13th.—Visit London General Omnibus Co., Ltd.

Saturday, November 14th.—Brooklands.

ITINERARIES FOR THREE DAYS' EXCURSIONS IN LONDON

(In the City) First Day

Drive along Grosvenor Place, beside Buckingham Palace Garden, to Hyde Park Corner, with Duke of Wellington's Statue and House, skirt Hyde Park by Park Lane, passing the Marble Arch, then to Portman Square, where the mansion described by Thackeray as "Gaunt House" in "Vanity Fair," and the splendid Wallace art collection will be visited. Returning to Oxford Street, fashionable Bond Street is taken to St. James Street and Marlborough Gate, near St. James Palace, and Marlborough House, home of the Prince of Wales. Crossing St. James Park by the Mall, Buckingham Palace is passed, and through the Westminster quarter, Westminster Roman Catholic Cathedral and Westminster Abbey are reached and their interiors visited. The Houses of Parliament, close by, are seen in proceeding to the National Gallery of British Art, whose treasures are inspected. Passing Green Park along Constitution Hill, Hyde Park, along Knightsbridge, parallel with Rotten Row, and the fine Church of the Oratory, the Victoria and Albert Museum (formerly Kensington Museum) is reached and its wonderful collection visited. Leaving here, the imposing Imperial Institute and various museums, Albert Memorial and Albert Hall are passed on the way to Kensington Palace, where relics of Queen Victoria's youth are shown. Returning toward the city, Kensington Gardens are crossed to the Dog's Cemetery in Hyde Park, and return made through West End to the hotel.

(In the City) Second Day

The second drive starts by the fine Thames Embankment, then goes through the heart of London by Queen Victoria Street, past St. Paul's Cannon Street, across historic London Bridge, by Tooley Street through Southwark, back across the Tower Bridge to the Tower. Here the famous prisons, the Armory, the Crown Jewels, etc., are visited. Passing the Royal Mint and Royal Exchange, the Bank of England, the Mansion

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House, Home of the Lord Mayor, and the shops of Cheapside with Bow Church, St. Paul's is reached and visited, including the Crypt, with its Tombs. Next come Ludgate Hill, Fleet Street, the Royal Courts of Justice and the Strand, Somerset House, great Public offices and depository of English wills, Whitehall Palace Banqueting Hall, the imposing War Office, the Admiralty, the Mounted Life Guards sentries, the principal State administration buildings, Chancery Lane, Public Record Office (interior), Lincoln's Inn Fields, with many famous residences, the Royal College of Surgeons and Sloane's Museum, the quaint Old Curiosity Shop House, Newcastle House, Freemasons' Hall, houses where Sheridan and Boswell lived, by Great Queen Street and Longacre to the British Museum. Here the Jewel Room, Waddesdon Collection and Reading Room will be inspected, and other great treasures. Return to hotel by convenient streets.

(Hampton Court) Third Day

From Ludgate Circus the outward journey is along the Victoria Embankment, and through Westminster to Chelsea, one of the most picturesque and interesting districts in London, associated with Carlyle, Turner, "George Eliot" and Rosetti. Parson's Green, Fulham, formerly famous for its pottery. Barnes Common and charming Priory Lane, leading to Richmond Park, with charming views, well-timbered and stocked with deer. Kingston on Thames, the place of coronation of the Saxon Kings. Hampton Court Palace, built by Cardinal Wolsey and presented by him to Henry VIII. The guide-lecturer will point out the principal objects of interest in the Picture Gallery and State Apartments. The Gardens, renowned for their old-fashioned charm and wealth of flowers, and the famous grape-vine, will also be visited. The return journey will be made through Bushey Park, with its renowned avenues of chestnuts. Teddington, with picturesque ivy-covered church. Strawberry Vale, close to which was the residence of the famous wit, Horace Walpole. Kew, with its famous Botanic Gardens. Turnham Green, where a skirmish took place between the Royalists and Parliamentarians. Hammersmith, with many old riverside mansions. Kensington, and its Palace and beautiful Gardens. Past Piccadilly, Leicester Square, Strand and Fleet Street, the drive terminates at Ludgate Circus about 5.30 P. M.

THE RETURN TRIP

The return to New York is scheduled via the North German Lloyd steamship George Washington, leaving Southampton on the 15th and arriving in New York on Saturday, November 21st.

COST OF THE TRIP

The steamship company has agreed to allow us a discount of 25 per cent. from published rates, the net of such discount, how-

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ever, not to maintain below the minimum first-class passenger rate of the steamers. The minimum rate on the Kaiser Wilhelm II from New York to Paris, via Cherbourg, is $134.50, and the minimum rate via the George Washington from London to New York via Southampton is $117.75. To these prices must be added the above-mentioned expense of $150 for the trip from Paris to London and also the expenses of the stay in Paris and London, as well as sight-seeing fees in the various cities. As to hotel expenses in Paris and London, rooms can be obtained at the hotels specified at from $2.50 up per day and table d'hote meals from 75 cents to $1.50. From the figures given a closely approximate estimate of the expense of the trip can be made.

The General Committee on Arrangements will be very glad to furnish any further information desired by the members, to facilitate their decision as to joining the party. The committee requests that the members get into immediate communication with it at the New York office of the Society, expressing their intention as to taking the trip, as it is only by knowing the number who will participate that the most satisfactory arrangements can be made.

Among those who have expressed their intention of making the second S. A. E. European visit are:

Mr. and Mrs. William G. Wall.
Mr. and Mrs. Henry Souther.
Mr. R. S. Fend.
Mr. Alden L. McMurtry.
Mr. and Mrs. Orrel A. Parker.
Mr. and Mrs. A. B. Cumner.
Mr. E. S. Fretz.
Mr. and Mrs. F. E. Moskovics and daughter.
Mr. and Mrs. C. S. Crawford.
Mr. John R. Cautley.
Mr. and Mrs. Henry C. Wilson.
Mr. and Mrs. Walter C. Baker.
Mr. and Mrs. Jos. A. Anglada.
Mr. Frank Burgess.
Mr. and Mrs. R. J. Nightingale.
Mr. B. B. Bachman.
Mr. Walter W. Norton.
Mr. and Mrs. George L. Markland, Jr., and daughter.
Mr. and Mrs. Herbert W. Alden.
Mr. and Mrs. E. G. Gunn.
Mr. R. D. Chapin.
Mr. and Mrs. James Levy.
Mr. Arthur J. Slade.

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MEMBERS INTENDING TO TAKE THE TRIP WILL PLEASE FILL OUT AND MAIL THE BLANK APPEARING ON PAGE 357.

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Paper presented at Summer Meeting

A SUGGESTION FOR THE STANDARDIZATION OF PNEUMATIC TIRE RIMS

By E. R. HALL.*

(Member of the Society)

The Council of the Society of Automobile Engineers has established a sub-committee of the Standards Committee called the Pleasure Car Wheels Division, the function of which is to attempt the standardization of wheels for automobiles. As a part of this work the consideration of the different types of rims on the market for pneumatic tires is necessary, as they affect in a large degree the specifications for the wheel itself, and furthermore, broadly speaking, the rim is a part of the wheel.

A cursory perusal of rim manufacturers' literature will suffice to show the great necessity for standardization, and the great difficulties which will have to be surmounted. There are at least 44 different types of rims in very general and extensive use, requiring at least fourteen different sections of wood felloes, not to speak of the different bolt-holes, special wood cutting to allow for special fastening devices, etc. Besides these well-known and popular rims there are a great many rims more or less complicated in design, each claiming certain attractive features, which are not so well known. These conditions work a hardship on the wheel-maker, who in many cases has to carry wood of a size to take care of the largest section required and in making the smaller felloes has to waste a large amount of costly hickory.

An association called the Clincher Automobile Tire Manufacturers' Association, which has a membership consisting of the leading tire manufacturers, and an associate membership consisting of practically all the rim manufacturers, was formed some years ago, and standardized the inside contours and tire seat diameters of all rims, but no attempt was made by it to standardize any special type of rim design. Any rim which met its tire-seating specifications, it passed, provided there was no feature in connection with the rim which could be injurious to the tire. Thus with no limitations whatsoever on fastening devices, etc., there has sprung up this very large number of different kinds of rims with which the market is now flooded.

There are six representative groups into which the various rims manufactured to-day can be classified, and the attempt will be made to pick out from each group one typical rim which will combine all the attractive and as few of the unattractive features of the rims of its group as possible. In the case of demountable rims we will simply attempt the selection of felloe bands, leaving the type of top rim optional.

*Experimental Engineer, Goodyear Tire and Rubber Company.

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The six representative groups are as follows:

I—One-Piece Clincher.

II—Quick Detachable Clincher.

III—Quick Detachable Straight-Side.

IV—Quick Detachable Universal.

V—Demountable.

VI—Demountable-Detachable.

The distinction between V and VI rests in the fact that there are a large number of demountable rims which have to be demounted before the tire can be removed from the rim, while there are others from which the tire can be removed while the rim still remains mounted on the wheel.

We will consider each group in the order above outlined.

I—THE ONE-PIECE CLINCHER RIM

This rim is made in one piece and is not cut in any direction; it will only receive regular clincher tires with soft extensible beads which can be pried over the edges of the rim. There is only one type of one-piece clincher rim on the market and the tire seat contour and diameter, as well as the thickness, have been standardized by the Clincher Automobile Tire Manufacturers' Association.

Although the design of this rim is illogical in some sizes, it has worked out very satisfactorily in practice, and it would be to my mind extremely bad practice and in fact practically impossible to make any change in the rim at this time. The rim has already been accepted by the Pleasure Car Wheels Division of the S. A. E. Standards Committee as a tentative standard.

The rim as standardized is shown in Fig. 1.

I recommend the adoption of this rim in its present form as standard.

QUICK DETACHABLE RIMS

In taking up the consideration of quick detachable rims, we have to face the fact that there are many designs of these rims on the market giving excellent satisfaction, and being made by different manufacturers, under their respective patents, and that they all have their very good points as well as their bad points. It is a difficult matter to pick a rim arbitrarily and say it is the best. What I have here tried to do is to select the rim which appears to combine most of the good points and has as few of the bad points as possible.

II—THE QUICK DETACHABLE CLINCHER RIM

These rims, of which there are many types, are all designed to permit easier application of a regular clincher tire, and to take the popular quick detachable clincher tire as well. This latter tire has a bead of clincher shape, partially or wholly inextensible, and it is not possible to pry it over the side of a one-piece clincher rim. These rims are all composed of two or more parts, consisting first of a rim base with an integral inside clinch, or separate inside endless clincher ring, and a separate outside clincher ring which is made either open with some fastening device for holding the

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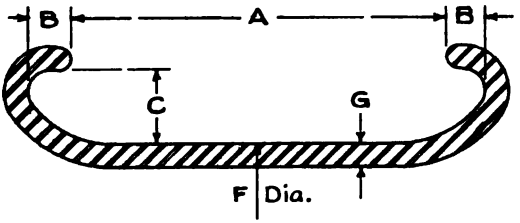
FIGURE 1



SIZE	A	B	C	G
3"	1.76	.255	.42	.126
3½"	2.05	.275	.48	.156
4"	2.42	.275	.48	.156
4½&5"	2.76	.390	.64	.172
5½&6"	3.50	.500	.78	.172

Dia. F = Nominal Tire Tread Diameter, minus twice nominal Tire Section Diameter.

Example:- 34"x4" Rim, Dia. F = 34-(2x4) = 26"

ends in place, or endless with an open lock ring to hold it in place. Examples of the most popular forms of quick detachable clincher rim are shown in section in Fig. 2.

Rim No. 1 is of the type which has a base, two endless clincher side-rings and an open-end lock ring which may be snapped out of its seat and so permit the removal of outside clincher ring and then tire. Rim No. 2 has the inside clinch integral with the rim base, the outside clincher ring and the lock ring being similar in action to those of rim No. 1, although different in design. Rims Nos. 3 and 4 are similar to rim No. 2, except that the outside clincher ring is open-ended, having some mechanical lock for the ends of the ring. Rim No. 5 has an open-end outside clincher ring, but the angle of the groove in the rim base in which it seats is such that the inflation of the tire causes it to seat home more firmly, so that no locking device is necessary. The simplest, most inexpensive and lightest type appears to be a type similar to rim No. 5. Fig. 3 shows a rim of this type which I suggest as a possible standard for a quick detachable clincher rim.

Very few rims of this design have been made and used, but those which have been in use have given very good satisfaction. There are a number of unusual difficulties which have to be overcome in its manufacture, but they can all be overcome and a satisfactory rim turned out that will easily meet all requirements as to strength, set, etc. Unfortunately, rims of this design are a little difficult to operate. They cannot, for instance, be

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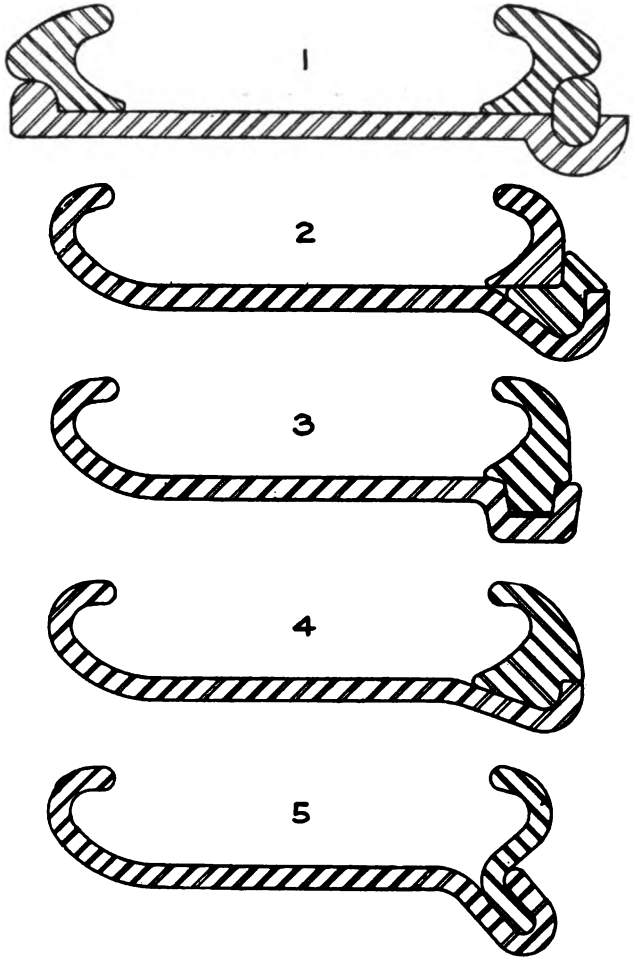
FIGURE 2



worked as easily as rims Nos. 1 and 2 (Fig. 2) as these latter rims have open rings of smaller and more flexible section, making them easier to remove and replace. I feel, however, that the advantages of simplicity, fewer parts, lightness, and the fact that no locking device is necessary, more than offset the disadvantage of the slightly more difficult operation.

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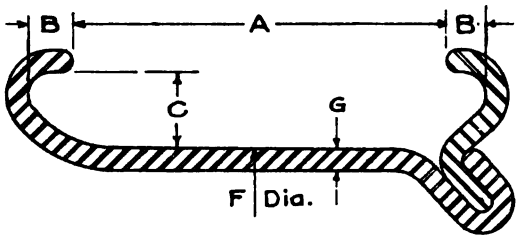
FIGURE 3



SIZE	A	B	C	G
3"	1.76	.255	.42	.126
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4"	2.42	.275	.48	.156
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5½&6	3.50	.500	.78	.172

Dia. F = Nominal Tire Tread Diameter, minus twice nominal Tire Section Diameter.

Example:- 34"x4" Rim, Dia. F = 34-(2x4) = 26"

III—THE QUICK DETACHABLE STRAIGHT-SIDE RIM

The straight-side rim is made to take any tire of the straight-side type. These tires all have inextensible beads and the only function of the rim is to hold the tire in place and support it. There is no hook to hold the tire down, this being taken care of by the inextensible bead of the tire itself. The quick detachable straight-side rims on the market are similar to the quick detachable clincher in their operation and in Fig. 4 are shown sections of the most popular types.

Rim No. 1 has two endless side-rings and an open locking rim. Rims Nos. 2 and 3 have inside flanges integral with the base, No. 2 having an endless outside ring and an open locking ring, and No. 3 having an open outside ring with some locking device. Rim No. 4 is similar to No. 3, except that the groove in which the outside ring seats is at such an angle that the tire forces it into place and no locking device is necessary.

Considering the rims in Fig. 4, the simplest, lightest and most inexpensive appears to be a type similar to rim No. 4. Fig. 5 shows a rim of this type which I suggest as a possible standard for a quick detachable straight-side rim.

A number of rims of this type have been on the market and given excellent satisfaction. It is the easiest possible straight-side rim to operate and there are no unusual manufacturing difficulties connected with its fabrication. When the proper material is used the rim is amply strong to meet all requirements as to strength, etc.

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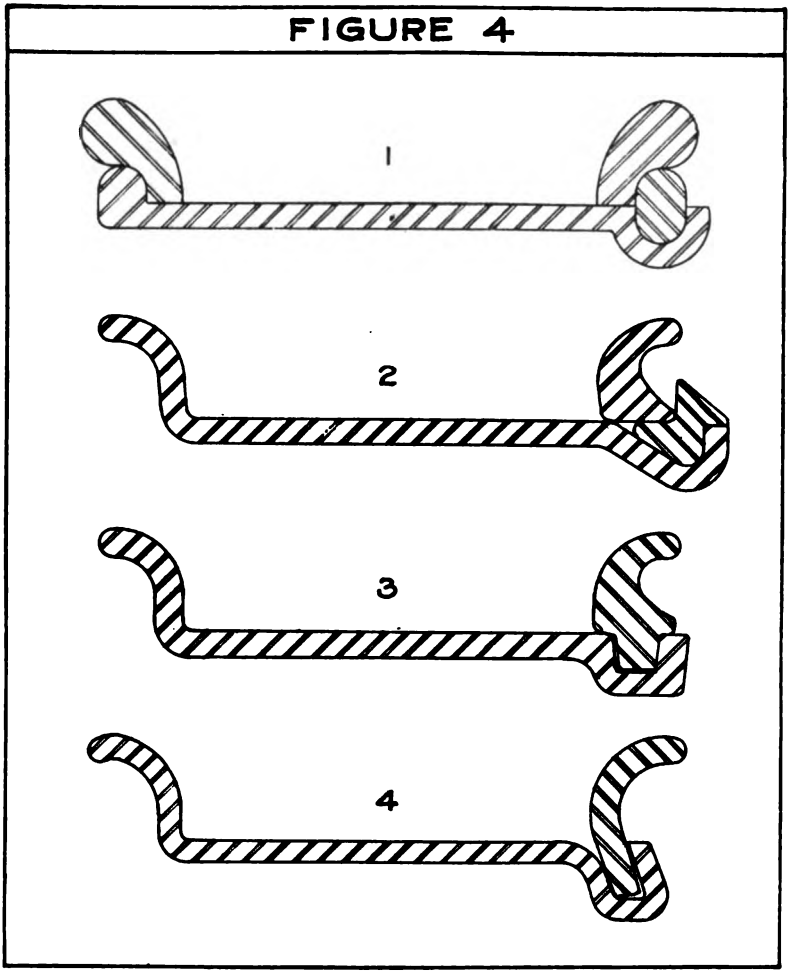
FIGURE 4



IV—UNIVERSAL QUICK DETACHABLE RIMS

The universal rim is made to take either the clincher or straight-side type of tire, all of these rims having a reversible side ring which will take clincher tires when the hooks are turned in, and straight-side tires when the hooks are turned out. There are a number of different types of universal quick detachable rims. In Fig. 6 examples of the most common designs in use are shown.

Rims Nos. 1 and 2 are alike except for the slight difference in section of the open-end lock ring. Rim No. 3 has an open-end side ring held in place by a locking device, which works equally well with the side ring in position for either the clincher or straight-side tire.

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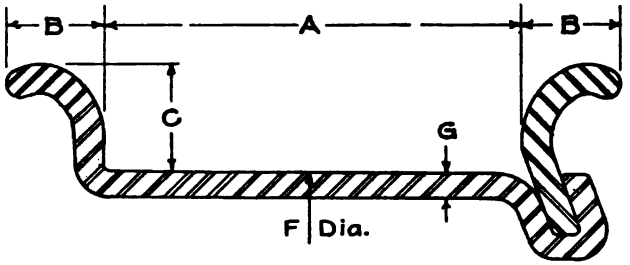
FIGURE 5



SIZE	A	B	C	G
3"	1.97	.553	.593	.125
3½"	2.31	.613	.687	.156
4"	2.69	.613	.687	.156
4½" & 5"	3.12	.683	.875	.172
5½" & 6"	3.83	.773	1.000	.172

Dia. F = Nominal Tire Tread Diameter, minus twice nominal Tire Section Diameter.

Example:- 34"x4" Rim, Dia. F = 34 − (2x4) = 26"

A very great number of universal rims have been made and are in use, but the demand for them is rapidly decreasing, due to the fact that to-day both clincher and straight-side tires can be obtained with equal ease and at practically the same price, so that there is no longer any occasion for a person to change from the type of tire he prefers, as was formerly the case. In view of the fact that in all probability there will be very few universal rims made in the future, we do not feel justified in causing the expense necessary in the adoption of a standard and the elimination of other designs. I do, however, recommend that the bases of all universal quick detachable rims be made of the same thickness as the corresponding sizes in one-piece clincher rims, which will allow the use of the same wood felloe with all.

DEMOUNTABLE RIMS

The consideration of demountable rims with a view to standardizing is even more difficult than that of detachable rims and more necessary as well, as the types are more varied, the rim is growing more in popularity and the wood felloe and wheel sizes are more varied in dimensions. The expense and hardship consequent upon standardization would be very great on account of the many types; and the possibility of convincing argument and test to back up a standard very small, due to the very slight differences

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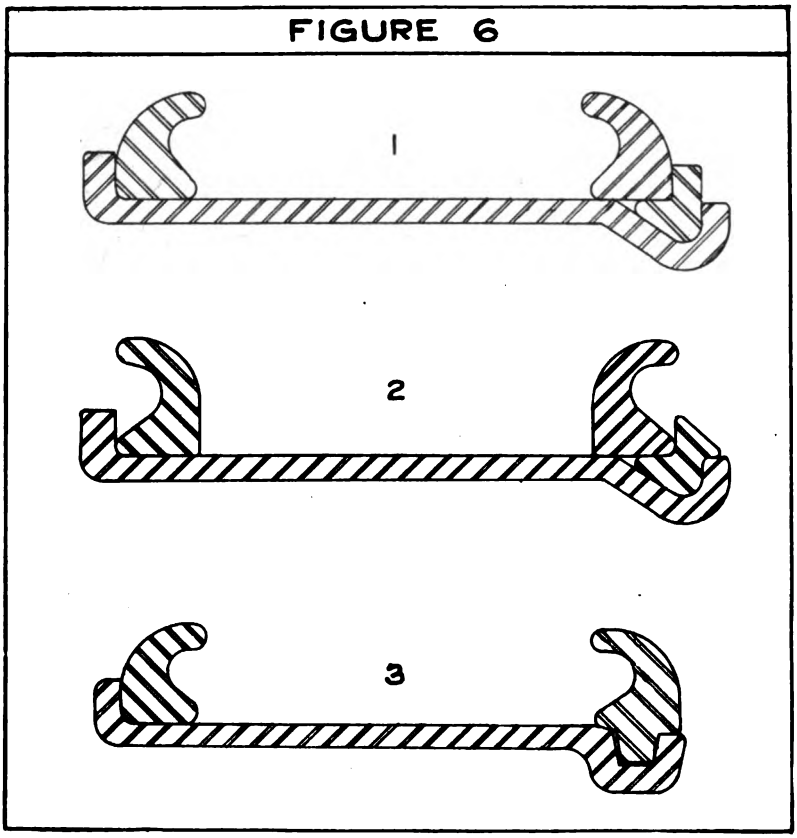
FIGURE 6



in operation of some of the rims, although they are materially different in design. Demountable rims all consist of a felloe band upon which can be mounted the tire-carrying rim, the rim being locked into place by a locking device. The rim can be a modification of any one of all the rims previously described in this paper, and also a large number of others, including the type which is transversely cut and which has to be demounted from the felloe band before the tire can be removed from the rim, a type of which there are a great number in use. The felloe bands are quite varied in design, but the most common are all made on the same principle—that of having the inside edge turned up at an angle upon which seats the rim which is held in place by lugs; sometimes with but more often without a lock ring.

It appears quite impossible to attempt the standardization of the tire-carrying rim further than to suggest that the many types used which resemble the quick detachable rims previously described in this paper, be brought down to those few types which are suggested for standards.

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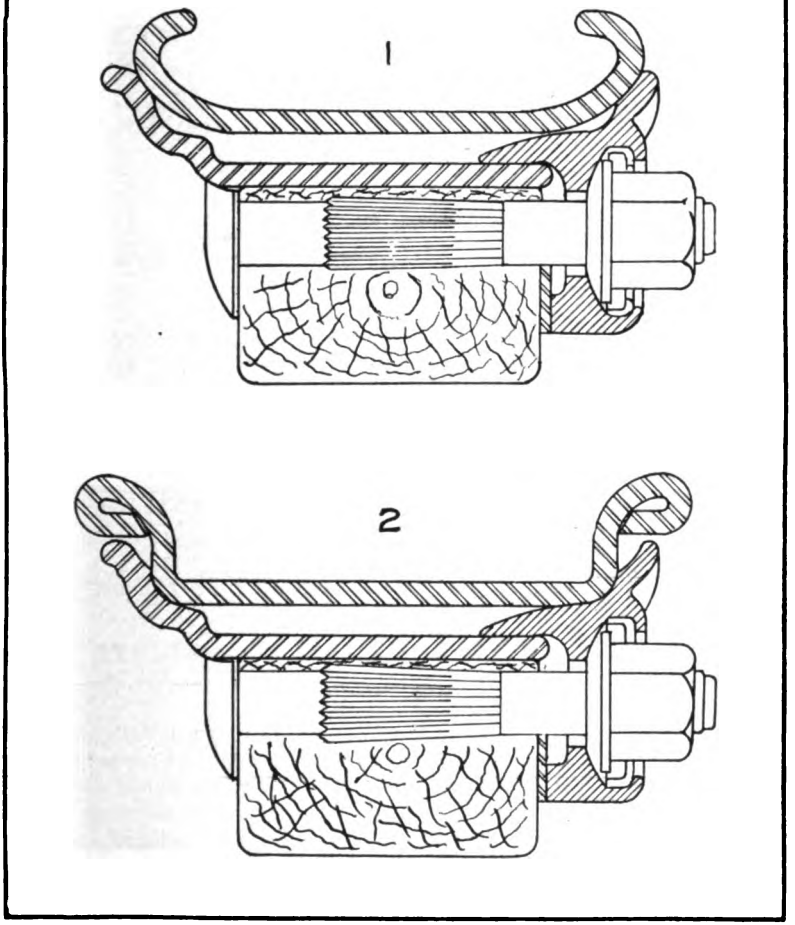
FIGURE 7



The standardization of fastening devices also appears impossible at this time.

The standardization of felloe bands appears feasible, although it seems impossible at this time to standardize on one single type. It is necessary to consider two. I suggest that any special rim which cannot be adapted to one of these two felloe bands be so designed as to fit a felloe band which requires a wood wheel the same size as the bands suggested for standard.

The majority of demountable rims can be classified under two headings —the demountable rim which has to be demounted from the felloe band

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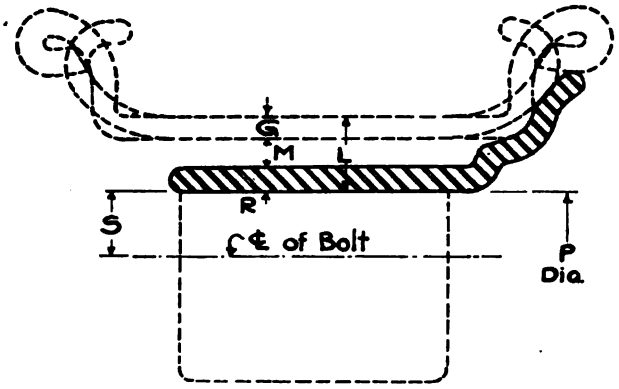
FIGURE 8



SIZE	G	M	R	L	S
3½"	.156	.187	.156	.500	.437
4"	.156	.187	.156	.500	.437
4½" & 5"	.172	.187	.156	.516	.437

Inside diameter of Felloe Band, P = Tire Seat diameter of Rim, minus 2×L

Example:- 34"×4" Felloe Band, P = 26-(2×.5) = 25"

before the tire can be removed, and the demountable-detachable from which the tire can be removed without demounting the rim. The former are for most part cold-rolled to shape from flat strip steel and mounted on a cold-rolled felloe band, which fits the rounded underside of the rim, leaving very little space between. The latter, demountable-detachable rims, are usually hot-rolled special shapes with ribs on the under side which engage a similar and opposed rib on a thick hot-rolled felloe band, leaving a somewhat larger space between.

V. THE DEMOUNTABLE RIM

In Fig. 7 are shown in section examples of two popular forms of demountable rims.

The felloe band and wood in both drawing No. 1 and No. 2 are the same, but in No. 1 a clincher rim is mounted, while in No. 2 a straight-side rim is mounted. Both tire-carrying rims are transversely cut and after demounting from the felloe band, can be collapsed and the tire removed.

In Fig. 8 is shown an example of a cold-rolled felloe band for demountable rims which I suggest for a standard.

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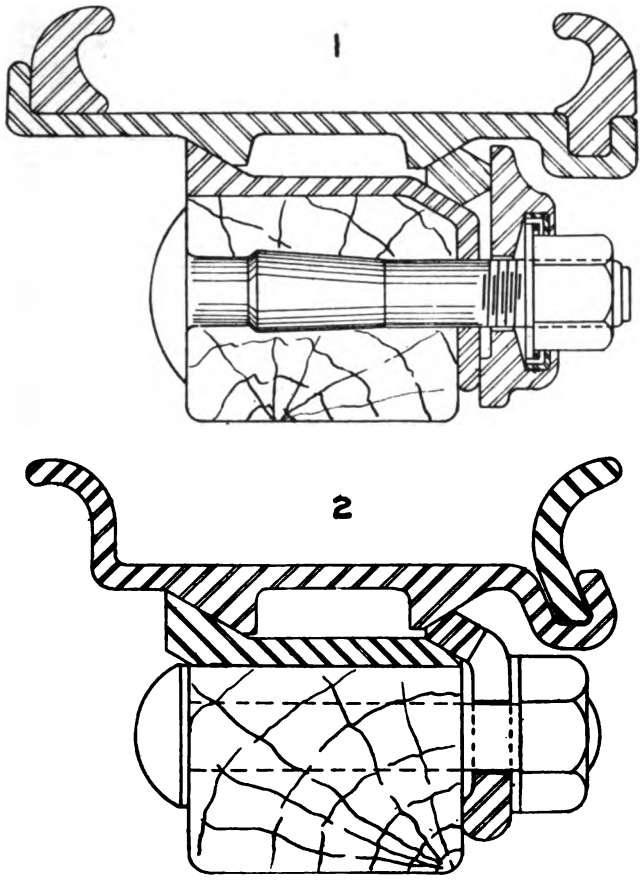
FIGURE 9.



This felloe band is so designed as to take either straight-side or clincher tire-carrying rim, and permits nearly the same variety of locking devices as are at present in use. The clearance between the felloe band and the under side of the rim is sufficient for the majority of rims of this type in use today. The location of the bolt-holes through the wood felloe is such that practically all the locking devices can be modified to use them to advantage. The band has sufficient section to properly pull and hold the wheel in form, when properly applied.

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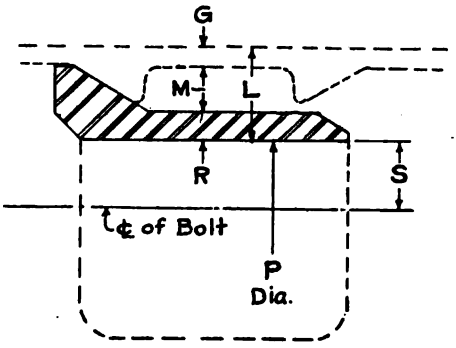
FIGURE 10



SIZE	G	M	R	L	S
3½	.156	.312	.187	.656	.437
4	.156	.312	.187	.656	.437
4½ & 5	.172	.312	.187	.672	.437

Inside diameter of Felloe Band, P = Tire Seat diameter of Rim, minus 2 x L

Example:- 34" x 4" Felloe Band, P = 26 - (2 x .656) = 24.688

VI. THE DEMOUNTABLE-DETACHABLE RIM

In Fig. 9 are shown examples of two popular forms of demountable-detachable rims.

In this case, although the felloe bands are very different in detail, the tire-carrying rims can be interchanged upon them. As is readily noted the tire can be removed by simply operating the detachable feature of the tire-carrying rim without the necessity of demounting the rim from the felloe band. In drawing No. 1 a fastening device using an open-end wedge-ring is used, while in drawing No. 2 the wedge-clip fastening without wedge-ring is used. Either type of fastening could be used on either felloe if the bolt-holes were standardized.

In Fig. 10 is shown a hot-rolled felloe band for demountable-detachable rims which I suggest for a standard.

Practically all of the hot-rolled demountable-detachable tire-carrying rims will either fit or can be modified to fit this felloe band, and any of the fastenings used with the same can also be used if modified to take bolts fitting in the holes located in the wood felloe, as shown. The clearance allowed between felloe band and rim is sufficient, and the section of band

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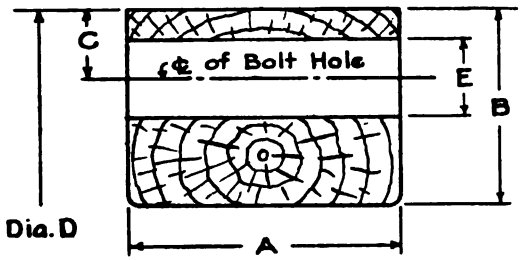
FIGURE 11



SIZE	A	B	C	E	DIA. D RIM TYPES I, II & III	DIA. D RIM TYPE IV	DIA. D RIM TYPE V
30 x 3½	1.50	1.25	.438	.438	22.688	22.000	21.688
32 x 3½					24.688	24.000	23.688
32 x 4	1.75	1.25	.438	.438	23.688	23.000	22.688
34 x 4					25.688	25.000	24.688
34 x 4½	2.00	1.25	.438	.438	24.656	23.968	23.656
36 x 4½					26.656	25.968	25.656

large enough to properly hold the wheel. The band is a simple one to roll and exactly checks with a great many now on the market.

For all demountable and demountable-detachable rims I suggest bolt-holes of 7/16" diameter, and the use of six bolts for all sizes under 36" tire-diameter, and eight bolts for 36" tire diameter and all sizes over that.

To recapitulate, the foregoing suggested standardization of rims gives the following five types.

I Standard One-Piece Clincher Rim.
II Standard Quick Detachable Clincher Rim.
III Standard Quick Detachable Straight-Side Rim.
IV Standard Demountable Felloe Band.
V Standard Demountable-Detachable Felloe Band.

The wheel-makers would be especially benefited by such a standardization, as the same wood felloe and wheel can be used for *I*, *II* and *III* above, *IV* and *V* each require its own wood felloe and wheel. and furthermore it appears quite possible to make the section of the wood felloe the same in all of the above five types.

In investigating present practice in felloe design, we find that sometimes

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the size of the spoke is specified and the felloe made wide enough to receive it; at other times the type of rim to be used is specified and the felloe is designed of good width to take the rim or felloe band. The depth of wood felloes manufactured by the different wheel-makers for pleasure automobiles varies but very little. Experience and practice seem to point out that good hickory felloes made to the dimensions listed in Fig. 11 give ample strength when built into pleasure automobile wheels of proper design, when any of the foregoing rims or felloe bands suggested for standardization are used and properly applied. Fig. 11 represents the average practice and felloe section design of the wheel-makers of this country and also incorporates proper diameters to take said rims and felloe bands.

I suggest these wood felloe dimensions as a standard to be used in all wheels for pleasure automobiles.

SECTION ASSOCIATE ENROLLMENT

The Council at a recent meeting authorized the Sections to put into force a form of affiliation known as Section Associate enrollment. Men who desire to be associated with Sections of the Society, but for good reasons find it inexpedient to become members of both the Society and a Section, may be registered by a Section upon request as Section Associates upon such terms and conditions as may be provided in the Section By-Laws. Applicants for such enrollment shall give as reference three members of the Section in question and state in the application the reason for applying for registration rather than membership in the Society. Applications will be subject to the approval of the governing bodies of the respective Sections.

The terms of registration shall be for the fiscal year of the Section or for half of said year. A Section Associate wishing to be registered for a second year will submit a new application; likewise for a third year. But in no event shall Section Associates be registered for more than three years. The registration fee shall be $5.00 for each annual registration or $2.50 for the second half of the first year.

The privileges of the Sections Associates shall consist of invitation to the meetings and other activities of the respective Sections; privilege of attendance at and participation in discussons; receipt of S. A. E. Bulletins and publications of the Sections. Section Associates shall not have the right to vote.

Any man may, with the approval of the governing body of a Section, register as a Section Associate, provided he is in its opinion qualified for membership of any grade in the Society, but shall not, however, be considered as a member of the Society or Section.

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Accepted at Summer Meeting

BROACHES DIVISION SUPPLEMENTARY REPORT

Referring to the nut shown on S. A. E., Data Sheets 7 and 7a of Vol. I, and especially to that in connection with the taper fittings, it appears that while some of our members have had satisfactory results from the plain nut shown in the table, others have had some difficulty due to the nut working loose since the cotter-pin does not prevent the nut loosening to some extent. It appears, therefore, that some provision should be made for a castle nut.

For convenience, we present herewith copies of Data Sheets 7 and 7a, as well as a similar table showing a castle nut and suitable dimensions therefor. It will be noted that the new table shown is identical with Data Sheet 7a with the exception that the symbol at the top of the ninth column is changd from *Tn* to *E*, the data in that column remaining as before except for two minor corrections on the second and third lines and a new column being added for *Tn*. Also, to allow of more easily lining up the cotter-pin slots and hole, the dimension *C* has been increased by 1/32" throughout. In other words, the data given are identical in the two instances excepting that the new column *Tn* is added and the dimension *C* is increased 1/32".

It should also be noted that the castle nut shown is in every case strictly interchangeable with the plain nut shown on 7a; that is, the shaft-end would be exactly the same regardless of which nut was used. This form of castle nut is already in use by the Timken-Detroit Axle Company and possibly some others. Conservative practice seems to demand the castle nut in many instances. The Broaches Division recommend that this be shown in data sheet form. They wish to be instructed by the Standards Committee or the Society or both as to whether the table showing the castle nut shall be shown *in addition* to the present tables, thus giving an alternate, *or* whether for conservative reasons the castle nut shall be approved as recommended practice in all cases and the table referring to the same *substituted* for that now on data sheet 7 of square fittings and 7a of taper fittings.*

Respectfully submitted,

BROACHES DIVISION,

C. W. SPICER, Chairman.

*At the June, 1914, meeting of the Society a vote was passed accepting the recommended table as to castle nut as *additional* practice.

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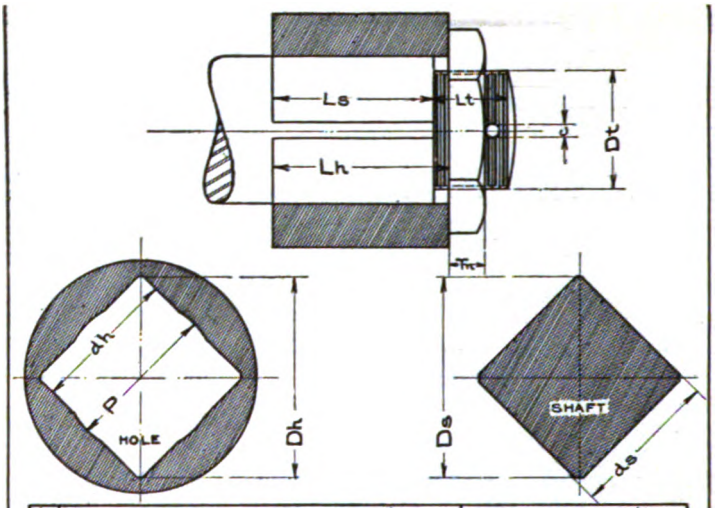

Nominal D.	PERMANENT FIT ds/Ds=.80														SLIP FIT ds/Ds=.73					
	P	ds	dh	Ds.	Dh	Le	Lh	Lt	Dt	N	Th	H	c	Cp	P	ds	dh	Ds	Dh	Cs
1/4	.193	.1895 .1885	.1875 .1865	.250 .245	.260 .252	5/16	3/8	5/16	3/16	32	5/32	4/32	1/16		.257	.248 .247	.250 .249	.3437 .3387	.3537 .3457	24
3/8	.290	.2832 .2822	.2812 .2802	.375 .370	.385 .377	7/16	1/2	7/16	1/4	28	7/32	3/8	5/64		.384	.373 .372	.375 .374	.5156 .5106	.5256 .5176	59
1/2	.386	.3770 .3760	.3750 .3740	.500 .495	.510 .502	11/16	3/4	7/16	5/16	24	17/64	1/2	5/64	49	33/64	.498 .497	.500 .499	.6875 .6825	.6975 .6895	10.
5/8	33/64	.5020 .5010	.5000 .4990	.625 .620	.635 .627	11/16	3/4	1/2	1/2	20	1/4	3/4	3/32	67	41/64	.623 .622	.625 .624	.8437 .8387	.8537 .8457	16
3/4	37/64	.5645 .5635	.5625 .5615	.750 .745	.760 .752	15/16	1	1/2	1/2	20	1/4	3/4	3/32	105	49/64	.748 .747	.750 .749	1.031 1.026	1.041 1.036	23.
7/8	45/64	.6895 .6885	.6875 .6865	.875 .870	.885 .877	1 1/8	1 1/4	5/8	5/8	20	5/16	1	1/8	130	29/32	.873 .872	.875 .874	1.187 1.182	1.207 1.192	32.
1	27/32	.8155 .8145	.8125 .8115	1.000 .995	1.020 1.009	1 1/2	1 5/8	3/4	3/4	20	5/16	1	1/8	175	1 1/32	.998 .997	1.000 .999	1.375 1.370	1.395 1.380	42.
1 1/8	29/32	.8780 .8770	.8750 .8740	1.125 1.120	1.145 1.130	1 3/8	1 1/2	5/8	3/4	20	5/16	1	1/8	250	1 5/32	1.123 1.122	1.125 1.124	1.562 1.557	1.582 1.567	53.
1 1/4	1 1/32	1.003 1.002	1.000 .999	1.250 1.245	1.270 1.255	1 3/8	1 1/2	5/8	1	20	5/16	1 1/2	1/8	260	1 9/32	1.248 1.247	1.250 1.249	1.687 1.682	1.707 1.692	66.
1 3/8	1 5/32	1.128 1.127	1.125 1.124	1.375 1.370	1.395 1.380	1 7/8	2	5/8	1	20	5/16	1 1/2	1/8	300	1 27/64	1.373 1.372	1.375 1.374	1.875 1.870	1.895 1.880	79.
1 1/2	1 5/32	1.128 1.127	1.125 1.124	1.500 1.495	1.520 1.505	1 7/8	2	5/8	1	20	5/16	1 1/2	1/8	450	1 35/64	1.498 1.497	1.500 1.499	2.062 2.057	2.082 2.067	94.
1 3/4	1 27/64	1.378 1.377	1.375 1.374	1.750 1.745	1.770 1.755	2 1/8	2 1/4	3/4	1 1/4	18	7/16	2 1/8	1/8	540	1 13/16	1.748 1.747	1.750 1.749	2.375 2.370	2.395 2.380	128.
2	1 35/64	1.504 1.503	1.5000 1.4985	2.000 1.995	2.020 2.005	2 3/8	3	3/4	1 1/4	18	7/16	2 1/8	1/8	800	2 1/16	1.9975 1.9965	2.0000 1.9985	2.750 2.745	2.770 2.755	168.
2 1/4	1 13/16	1.754 1.753	1.7500 1.7485	2.250 2.245	2.270 2.265	2 7/8	3	3/4	1 1/4	18	7/16	2 1/8	1/8	940	2 5/16	2.2475 2.2465	2.2500 2.2485	3.062 3.057	3.082 3.067	210.
2 1/2	2 1/16	2.004 2.003	2.0000 1.9985	2.500 2.495	2.520 2.505	3 3/8	3 1/2	1 1/8	2	16	5/8	3 1/8	3/8	1050	2 37/64	2.4975 2.4965	2.5000 2.4985	3.437 3.432	3.457 3.442	263.
2 3/4	2 5/16	2.254 2.253	2.2500 2.2485	2.750 2.745	2.770 2.755	3 3/8	3 1/2	1 1/8	2	16	5/8	3 1/8	3/8	1250	2 59/64	2.7475 2.7465	2.7500 2.7485	3.750 3.745	3.770 3.755	315.
3	2 37/64	2.504 2.503	2.500 2.4985	3.000 2.995	3.020 3.005	3 7/8	4	1 1/8	2	16	5/8	3 1/8	3/8	1300	3 3/32	2.997 2.996	3.000 2.998	4.125 4.120	4.145 4.130	379.
3 1/2	2 55/64	2.754 2.753	2.750 2.748	3.500 3.495	3.520 3.505	4 3/8	4 1/2	1 1/4	2 1/2	14	3/4	3 7/8	1/4	2200	3 15/64	3.447 3.446	3.500 3.498	4.750 4.745	4.770 4.755	514.
4	3 23/64	3.254 3.253	3.250 3.248	4.000 3.995	4.020 4.005	5 3/8	5 1/2	1 1/4	2 1/2	14	3/4	3 7/8	1/4	2800	4 1/8	3.997 3.996	4.000 3.998	5.500 5.495	5.520 5.505	672.

P = NUMBER OF THD PER P CAPACITY IN FT. LBS. PER 1" LENGTH AT 10000 LBS. PRESS. PER SQ. IN.
H = SHORT DIA. OF NUT. C = CAPACITY IN FT. LBS PER 1" LENGTH AT 10000 LBS. PRESS. PER SQ. IN.

Square Broached Fittings, S. A. E. Data Sheet 7 (Vol. I)

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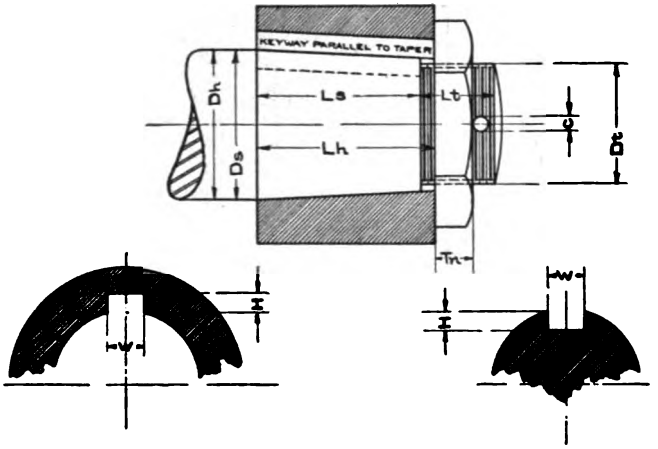
TAPER FITTINGS



Nominal O.D.	TAPER - 1½ IN 12.												
	Ds SHAFT	Dh HOLE	Ls	Lh	Lt	Dt	Thds per inch	Tn	Short dia. of nut	W	H	SQUARE KEY	c
1/4	.250 .249	.248 .247	5/16	3/8	5/16	3/16	32	5/32	9/32	.0625 .0620	.0337 .0327	.0635 .0630	1/16
3/8	.375 .374	.373 .372	7/16	1/2	7/16	5/16	24	17/64	1/2	.0937 .0932	.0494 .0484	.0947 .0942	5/64
1/2	.500 .499	.498 .497	11/16	3/4	7/16	5/16	24	17/64	1/2	.1250 .1245	.0650 .0640	.1260 .1255	5/64
5/8	.625 .624	.623 .622	11/16	3/4	1/2	1/2	20	1/4	3/4	.1562 .1557	.0806 .0796	.1572 .1567	3/32
3/4	.750 .749	.748 .747	15/16	1	1/2	1/2	20	1/4	3/4	.1875 .1870	.0963 .0953	.1885 .1880	3/32
7/8	.875 .874	.873 .872	1 1/8	1 1/4	5/8	5/8	20	5/16	1	.2500 .2490	.1275 .1265	.2510 .2505	1/8
1	1.001 .999	.997 .995	1 3/8	1 1/2	5/8	3/4	20	5/16	1	.2500 .2490	.1275 .1265	.2510 .2505	1/8
1 1/8	1.126 1.124	1.122 1.120	1 3/8	1 1/2	5/8	3/4	20	5/16	1	.3125 .3115	.1610 .1590	.3140 .3130	1/8
1 1/4	1.251 1.249	1.247 1.245	1 3/8	1 1/2	5/8	1	20	5/16	1 1/2	.3125 .3115	.1610 .1590	.3140 .3130	1/8
1 3/8	1.376 1.374	1.372 1.370	1 7/8	2	5/8	1	20	5/16	1 1/2	.3750 .3740	.1925 .1905	.3765 .3755	1/8
1 1/2	1.501 1.499	1.497 1.495	1 7/8	2	5/8	1	20	5/16	1 1/2	.3750 .3740	.1925 .1905	.3765 .3755	1/8
1 3/4	1.751 1.749	1.747 1.745	2 1/8	2 1/4	3/4	1 1/4	18	7/16	2 1/8	.4375 .4365	.2237 .2217	.4390 .4380	1/8
2	2.001 1.999	1.997 1.995	2 7/8	3	3/4	1 1/4	18	7/16	2 1/8	.5000 .4990	.2550 .2530	.5015 .5005	1/8
2 1/4	2.252 2.248	2.245 2.242	2 7/8	3	3/4	1 1/4	18	7/16	2 1/8	.5625 .5610	.2962 .2912	.5645 .5630	1/8
2 1/2	2.502 2.498	2.495 2.492	3 3/8	3 1/2	1 1/8	2	16	5/8	3 1/8	.6250 .6235	.3275 .3225	.6270 .6255	3/16
2 3/4	2.752 2.748	2.745 2.742	3 3/8	3 1/2	1 1/8	2	16	5/8	3 1/8	.6875 .6860	.3587 .3537	.6895 .6880	3/16
3	3.002 2.998	2.995 2.992	3 7/8	4	1 1/8	2	16	5/8	3 1/8	.7500 .7485	.3900 .3850	.7520 .7505	3/16
3 1/2	3.502 3.498	3.495 3.492	4 3/8	4 1/2	1 1/4	2 1/2	14	3/4	3 7/8	.8750 .8735	.4525 .4475	.8770 .8755	1/4
4	4.002 3.998	3.995 3.992	5 3/8	5 1/2	1 1/4	2 1/2	14	3/4	3 7/8	1.0000 .9985	.5150 .5100	1.0020 1.0005	1/4

S. A. E. Data Sheet 7a (Vol. I)

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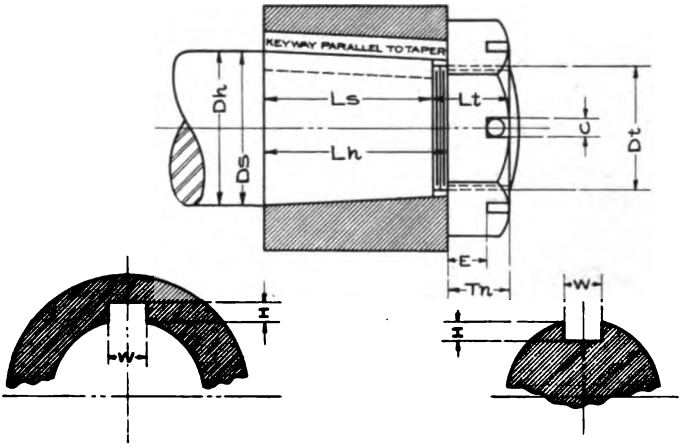
TAPER FITTINGS



Nominal Dia.	TAPER 1½ IN 12														
	Ds SHAFT	Dh HOLE	Ls	Lh	Lt	Dt	Thds per inch	E	Tn	Short dia. of nut	W	H	SQUARE KEY	C
¼	.250 .249	.248 .247	5/16	3/8	5/16	3/16	32	5/32	1/4	9/32	.0625 .0620	.0337 .0327	.0635 .0630	3/32
3/8	.375 .374	.373 .372	7/16	1/2	7/16	5/16	24	15/64	3/8	1/2	.0937 .0932	.0494 .0484	.0947 .0942	7/64
1/2	.500 .499	.498 .497	11/16	3/4	7/16	5/16	24	15/64	3/8	1/2	.1250 .1245	.0650 .0640	.1260 .1255	7/64
5/8	.625 .624	.623 .622	11/16	3/4	1/2	1/2	20	1/4	7/16	3/4	.1562 .1557	.0806 .0796	.1572 .1567	1/8
3/4	.750 .749	.748 .747	15/16	1	1/2	1/2	20	1/4	7/16	3/4	.1875 .1870	.0963 .0953	.1885 .1880	1/8
7/8	.875 .874	.873 .872	1 1/8	1 1/4	5/8	5/8	20	5/16	1/2	1	.2500 .2490	.1275 .1265	.2510 .2505	5/32
1	1.001 .999	.997 .995	1 3/8	1 1/2	5/8	3/4	20	5/16	1/2	1	.2500 .2490	.1275 .1265	.2510 .2505	5/32
1 1/8	1.126 1.124	1.122 1.120	1 3/8	1 1/2	5/8	3/4	20	5/16	1/2	1	.3125 .3115	.1610 .1590	.3140 .3130	5/32
1 1/4	1.251 1.249	1.247 1.245	1 3/8	1 1/2	5/8	1	20	5/16	1/2	1 1/2	.3125 .3115	.1610 .1590	.3140 .3130	5/32
1 3/8	1.376 1.374	1.372 1.370	1 7/8	2	5/8	1	20	5/16	1/2	1 1/2	.3750 .3740	.1925 .1905	.3765 .3755	5/32
1 1/2	1.501 1.499	1.497 1.495	1 7/8	2	5/8	1	20	5/16	1/2	1 1/2	.3750 .3740	.1925 .1905	.3765 .3755	5/32
1 3/4	1.751 1.749	1.747 1.745	2 1/8	2 1/4	3/4	1 1/4	18	7/16	5/8	2 1/8	.4375 .4365	.2237 .2217	.4390 .4380	5/32
2	2.001 1.999	1.997 1.995	2 7/8	3	3/4	1 1/4	18	7/16	5/8	2 1/8	.5000 .4990	.2550 .2530	.5015 .5005	5/32
2 1/4	2.252 2.248	2.245 2.242	2 7/8	3	3/4	1 1/4	18	7/16	5/8	2 1/8	.5625 .5610	.2962 .2912	.5645 .5630	5/32
2 1/2	2.502 2.498	2.495 2.492	3 3/8	3 1/2	1 1/8	2	16	5/8	1	3 1/8	.6250 .6235	.3275 .3225	.6270 .6255	7/32
2 3/4	2.752 2.748	2.745 2.742	3 3/8	3 1/2	1 1/8	2	16	5/8	1	3 1/8	.6875 .6860	.3587 .3537	.6895 .6880	7/32
3	3.002 2.998	2.995 2.992	3 7/8	4	1 1/8	2	16	5/8	1	3 1/8	.7500 .7485	.3900 .3850	.7520 .7505	7/32
3 1/2	3.502 3.498	3.495 3.492	4 3/8	4 1/2	1 1/4	2 1/2	14	3/4	1 1/8	3 7/8	.8750 .8735	.4525 .4475	.8770 .8755	9/32
4	4.002 3.998	3.995 3.992	5 3/8	5 1/2	1 1/4	2 1/2	14	3/4	1 1/8	3 7/8	1.0000 .9985	.5150 .5100	1.0020 1.0005	9/32

ACCEPTED ADDITIONAL TABLE

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NON-GLARING HEADLIGHTS

CHAIRMAN JOSEPH A. ANGLADA:—Gentlemen, the object of this meeting is to discuss the theory and operation of non-glaring headlights and to show the devices in operation. As you know, it will be unfair to draw conclusions relative to the comparative efficiency of the devices, because we have not laboratory or road conditions here in the meeting room. The various lights have lamps of different candle-power as well as of different construction. If we wanted to draw scientific comparisons, laboratory apparatus would, of course, be necessary.

WARD LEATHERS*:—In our original experiment a small disk was placed in front of the filament to cut off a portion of the light and reflect it back into a large parabolic reflector and thereby scatter the rays, getting some of them on the road; a sprayed light rather than a direct one. Unfortunately enough of the rays got into the large reflector to throw a direct ray forward into pedestrians' eyes. A little glare could always be discerned.

We are now trying to get a device that can be placed in a lamp and be controlled from the seat. We have borne in mind all the time that it is necessary not only to eliminate the glare but keep the light on the road, because the source of light is very small. With only 12 to 24 candlepower in the headlight it is absolutely necessary that the rays be very intelligently directed if you want to get any light on the road. We attempted to merely shelter them by means of a more or less spherical disk of aluminum or celluloid snapped over the bulb. This device worked successfully in that it eliminated the glare, but it did not give enough light on the road. We then tried a new method of procedure. We believed it would be possible to get the light on the road by means of a piece of glass of the right prism, and spent considerable time and money in developing this scheme. This also was found to be theoretically accurate and reasonably practicable, but we discovered that in order to make the lenses so they would actually do the work, they would cost about $50 apiece. They have to be practically perfect devices to do the work. The rays can be deflected to any desired angle and positively spread over the road without causing any glare.

We decided that we could throw the rays forward by means of a little lamp, and get them through a large reflector, thereby partly keeping them on the road and not in the pedestrian's eyes. This worked very well but requires a large source of light to get the light on the road.

We plotted carefully a curve which would catch the rays from the filament and throw them approximately parallel, and then set it at suf-

*Legalight Manufacturing Company.

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ficient angle to get the topmost rays below the pedestrian's eyes 6 or 8 feet in front of the car. When the reflector catches the rays from an ordinary lamp it will throw them forward parallel and operates at any angle we desire. We tried several angles and found 15 degrees very satisfactory. But the few stray rays that get into the edges of the big reflector caused just as much glare, apparently, as if they all got in. So we had only half solved the problem.

We finally did get a very sensible solution. We used not only a sectional reflector back of the bulb for the purpose of catching the rays and throwing them forward, but added to that a straight apron for the purpose of eliminating any possible rays that might sneak into the big reflector. This little supplementary reflector is adapted for attachment to any Ediswan socket and is secured by means of a focusing device.

J. F. MIDDLETON:—We all know that in riding at night we want to see as far ahead as possible. We do not want to put our light out, we do not want to dim it, we do not want to screen it; we want all the light we can get and far enough ahead to make it available for speedy riding. The thing to do is to get at the root of the matter. I had that in mind in splitting the reflector in two, horizontally, distorting the glaring rays that meet the eye, but still throwing enough light ahead on the road. You can see all around you and see where the other fellow is going, and still have light ahead. By touching a button on the steering-wheel, or any other convenient place, I break the glare. By touching the button again after you have passed your neighbor you have the light projected ahead again. The device is very simple (hinged top and bottom) and can be worked by a solenoid or any electromagnet.

NORMAN MACBETH—A great many of the headlight difficulties we have had in the past have been due to the light sources used. In the case of electric incandescent lamps the filament construction and form were of such a character that it was impossible to design reflectors that would properly direct the light. Glare has been defined as misplaced light. Blinding and glare effects from automobile headlamps are due entirely to improperly designed reflectors and unsatisfactory combinations of lamp and reflector. The solution lies in proper control of light, in the use of reflectors of exact design having a finish which may be maintained throughout a reasonable life.

I believe that in themselves the electric incandescent lamps used are not the cause of glare. While they are bright, the filament is so condensed that it is effective on a very small spot in the retina of the eye. Even the most casual examination of a number of concentrated filament mazda lamps, ranging from 6 to 30 candlepower, will bring out this point most forcefully. On lighting them you will find that the eye can judge area only and not intensity or brightness, and that to the eye there will be little apparent difference between even 6 and 30 candlepower lamps. A reflector, however, enlarges the small filament spot to several hundred times its actual size. Directing the reflector so that it fills the retina, you are bound to get a blinding effect due to the enormous stimulation of the proportionately large affected parts of the retina.

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Headlight tests and legislation in railroad work offer many suggestions to the automobile engineer. The law affecting railroads in twelve States calls for a light generating 1500 candlepower. Recent tests have shown that with a 120-candlepower lamp with the proper reflector, objects were picked up from 1 4/5 to 2½ times as far ahead on the track as by the higher candlepower legally approved lamp. J. G. Scrugham in a recent article on electric headlights,* in commenting on the candlepower ratings of headlights, stated that "there seems to be an almost unanimous opinion that the light reflected ahead should be of sufficient volume to enable the engineer to discern any serious obstruction on the track in time to prevent or minimize the danger of an accident,—that the object must become visible at a distance of 500 to 1000 feet (the braking distance of an express train running 60 miles an hour is 1200 to 1500 feet, depending upon road conditions) and that the light should not be so strong and dazzling as to blind observers or approaching enginemen." It has been shown that an illumination intensity of 1/10 footcandle (the intensity of illumination from a source of 1 candlepower at a distance of 3.16 feet) is sufficient to render distinctly visible at the distance of 1000 feet a dark object the size of a man. Prof. Scrugham advised that all trials should be based on the discernment of dark objects on the track, also noting that a 500- or 5000-candlepower light was of little use in preserving the lives of the traveling public unless properly reflected and directed where needed.

An ideally perfect projector would have a uniform parallel beam at all practical distances, a condition that is neither actually realizable nor practically desirable. In practice any headlamp may be considered as producing a slowly diverging beam, the luminous intensity in any direction near to the axis falling off nearly inversely as the square of the distance from the headlamp. At considerable distances this approximates in photometric behavior to a point source. There is no more difficult or exacting problem in light control than the projecting of the necessarily narrow bundle of light rays directly ahead and downward as required for automobile headlight service. It is necessary that the reflector be so designed that every ray of light impinging on its surface will be redirected in a line parallel with the axis of the reflector. This is done with a parabolic reflector. In the case of the reflected light the source of light must be placed at the focus *F*, Fig. 1. There will be a cone of light as shown in Fig. 1, 100 degrees in the case of the metal reflector and 142 degrees with the Matisse spherical paraboloid reflector which will not be under the influence of the reflector, but the remaining light falling within the reflector will be projected along the lines parallel with the axis. With a perfect reflector and a point source of light in a clear non-absorbing medium this beam would be projected to infinity without increase or decrease of intensity. The equivalent candlepower of this beam, in terms of an unreflected light source, would be stated in accordance with the law of inverse squares. At a distance of 1 foot

*Journal of Electricity, Power & Gas, Feb. 7, 1914.

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from the source the reflected apparent candlepower of a 24-candlepower lamp would probably be about 70 candlepower, which at 100 feet would be 10,000 times this amount, or 700,000 candlepower. Owing to the limitations in practical reflector manufacture and particularly the impossibility of obtaining a true point source of light, the rays emanating from the portions of the incandescent filament outside of the focal point of the reflector will diverge depending upon the ratio of the maximum distance of part of the light source from the focal point, to the focal length of the reflector. With a 2¼ inch focal length and an overall length of incandescent filament of less than a half inch, it has been possible with a Matisse spherical paraboloid reflector to confine the light reaching the reflector within the remarkably small angle of approxi-

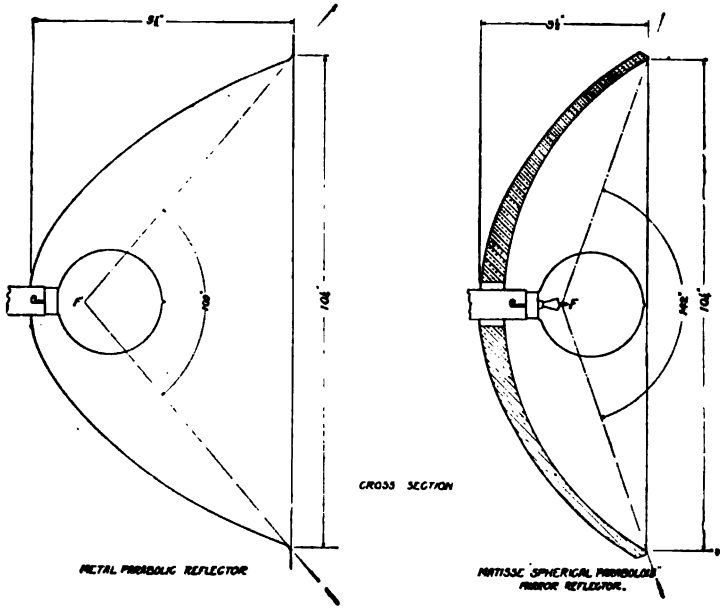

Fig. 1.

mately 3 degrees. The width of roadway covered by a beam of this divergence is 10½ feet at 200 feet ahead, 21 feet at 400 feet head, and 31½ feet at 600 feet distant. With two headlamps the beams may be paralleled or combined to cover a greater or less width of road as may be desired. The lamps to be adjusted so that the top of the beam shall not be more than 5 feet above the road at 400 or 500 feet ahead.

The back or outside surface of the Matisse spherical paraboloid mirrored glass reflector is ground to parabolic form, plated with pure silver in airtight contact with the glass, and reinforced with a heavy electroplating of copper which in turn is further protected with a noncorrosive heat-resisting metallic paint. The inside or exposed surface of this

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reflector is of polished glass hemispherical in form, resulting in a varying thickness of glass from the apex of the parabola to the outer edge. This varying thickness of glass results in a refractive action of the light rays tending to increase the efficiency of the parabola.

Tests were made by the Electrical Testing Laboratories, New York, of the two reflectors shown in section in Fig. 1. The metal parabolic reflector chosen was of the best kind procurable and was plated and carefully polished prior to the test that the most representative results might be secured. A 24 candlepower mazda automobile lamp of the focusing type was used in the tests and the photometric distance was 30 ft. with check tests at 50 ft. and 75 ft. These latter tests showed that the beam from each reflector was divergent and that the illumination intensity varied with the inverse square law.

The remarkable efficiency of the glass reflector was shown by a beam candlepower of 34,000 with 4,000 at 2½° and only 120 candlepower at 5°, showing a practical confining of the beam within the desirable narrow angle of less than 3°. As this reflector is shallow, there is a large proportion of the light from the lamp available for the illumination of objects from immediately in front of the wheels to 30 ft. distant.

The results of these tests are shown in graphical form in Fig. 2. The apparent candlepower values, as two headlamps are used on each car, were combined, resulting in a beam intensity of 68,000 candlepower with a Matisse spherical paraboloid reflector and 12,000 candlepower with metal reflectors. In plotting the latter the extra width of beam is cross-hatched. This represents that portion of the light which cannot possibly be effective but which through its blinding action actually renders many accidents not only possible but is also directly the cause of them.

The recent production by the incandescent electric lamp manufacturers of the ductile tungsten wire in a concentric helix form of filament, results in a remarkably concentrated light source which will admit of a concentration of light not possible with any of the light sources heretofore available. These lamps will admit of a beam 13½ times the intensity possible with the older types of lamps, when using, of course, properly designed reflectors. In making up lamps it is not commercially practicable to get the filament in exactly the same position in every bulb. Although the limits recognized are small (about 1/16 of an inch), provision should be made for adjustment of the lamp socket so that the filament can be centered accurately at the focal point of the reflector. Means should also be provided for the proper adjustment of the headlamps in relation to the width and height of the lamp brackets.

There can be no possible deterioration of these glass reflectors—the silver surface is protected from the air and the polished glass interior surface can be kept in perfect condition by merely wiping off or washing out the accumulated dust. It may be possible to stamp or spin a properly designed metal reflector. The metal finish, however, becomes tarnished and dust-covered with a consequent loss in light control and high absorption; then with repeated cleaning and polishing, the dust particles

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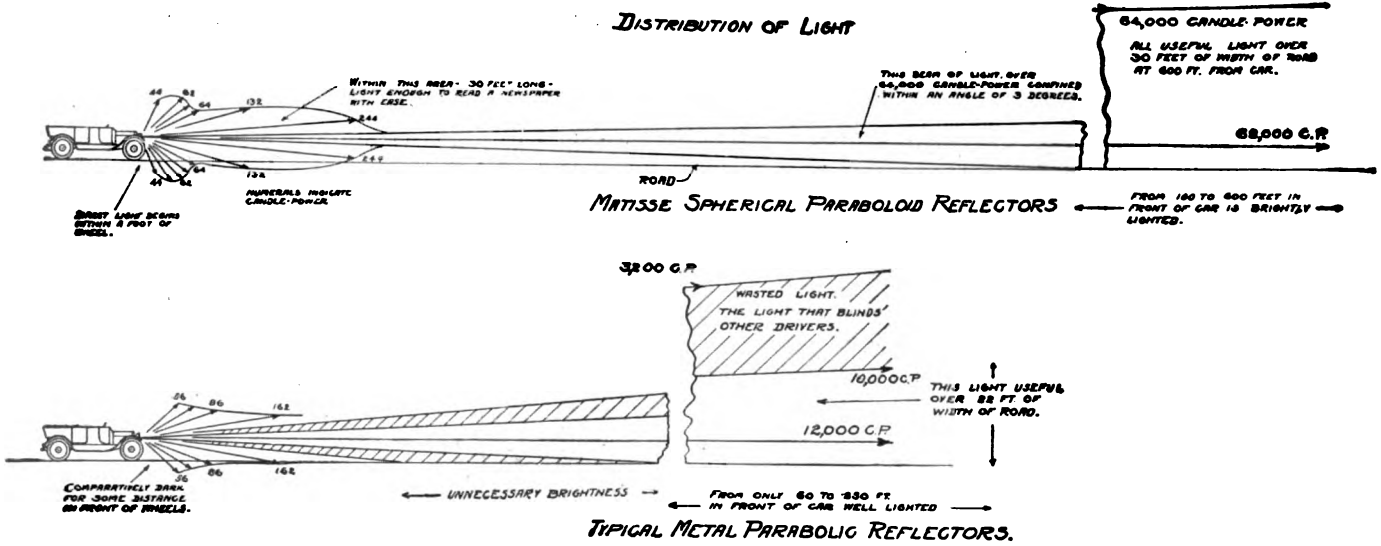
DISTRIBUTION OF LIGHT
64,000 CANDLE-POWER
ALL USEFUL LIGHT OVER 30 FEET OF WIDTH OF ROAD AT 600 FT. FROM CAR.
68,000 C.P.
WITHIN THIS AREA - 30 FEET LONG - LIGHT ENOUGH TO READ A NEWSPAPER WITH EASE.
THIS BEAM OF LIGHT, OVER 64,000 CANDLE-POWER CONFINED WITHIN AN ANGLE OF 3 DEGREES.
ROAD
BRIGHT LIGHT BEAMS WITHIN A FOOT OF WHEEL.
HUNDREDS IN USEFUL CANDLE-POWER.
MATISSE SPHERICAL PARABOLOID REFLECTORS
FROM 160 TO 600 FEET IN FRONT OF CAR IS BRIGHTLY LIGHTED.
3200 C.P.
WASTED LIGHT.
THE LIGHT THAT BLINDS OTHER DRIVERS.
10,000 C.P.
THIS LIGHT USEFUL OVER 22 FT. OF WIDTH OF ROAD.
12,000 C.P.
COMPARATIVELY DARK FOR SOME DISTANCE IN FRONT OF WHEELS.
UNNECESSARY BRIGHTNESS
FROM ONLY 60 TO 230 FT. IN FRONT OF CAR WELL LIGHTED
TYPICAL METAL PARABOLIC REFLECTORS.

Fig. 2.—Graphical representation of the distribution of light from Matisse and metal reflectors. The length of a line from the curve to the lamp represents the apparent candlepower in that given direction. The reflectors on both cars are equipped with 24 candlepower mazda lamps.

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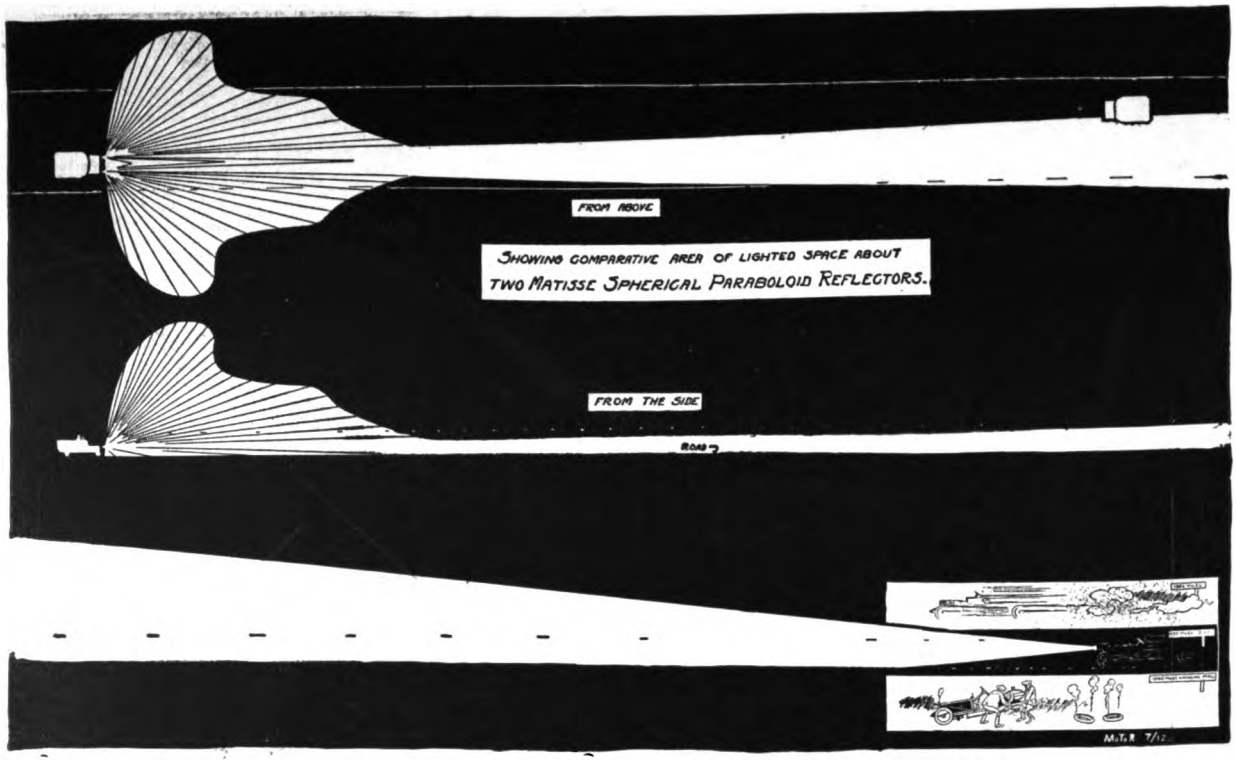

Fig. 3.—Beam of light from two Matisse spherical paraboloid reflectors. The approaching car, on the right, is outside the zone of light at 250 feet from car. "Eye-height" is shown by the dotted line. Below, the light from the usual reflector, most of the beam above eye-height.

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on the reflector when rubbed over the metal surface to be cleaned, most thoroughly scratch it up, each scratch, even though microscopic, serving to change the direction of the impinging light rays. I have seen reflectors which had been in use only six weeks badly scratched. Others, having practically a dust-tight housing and plated with nickel, which, while not as good a reflecting surface, does not tarnish as rapidly as silver, have appeared to be in reasonably good condition even after several months' use. A thoroughly scratched metal reflector, although conforming in contour to an ideal parabola, will have about the same light-distributing efficiency and width of distribution as would result from an enameled wash basin used as a reflector.

For city driving, in addition to using effective reflectors, a switch may be used which will temporarily reduce the light produced and also the energy demand, by using the lamps in the two headlights in series. Another device is now being perfected whereby by pressing a button on the dash, the incandescent electric bulbs will be tilted upwards in these present reflectors, just enough to alter the focus, with the result that all the reflected light is directed on to the roadway within a hundred feet in front of the car.

JOSEPH T. ROFFY:—In constructing a glareless lamp the first thing is to eliminate the direct glare of the filament; second, the projected beam should not rise above 4½ feet from the ground; third, the projected beam should be in a uniform field of light.

The projected field of the Roffy lamp is an achromatic field free from streaks and rings due to image formation that characterizes parabolic or other reflected beams of light. The lamps when mounted on a car project a cone of light as shown in Fig. 4.

We have provided a series-parallel switch for use when the car is standing, and in traveling lighted streets. There is no glare, no matter

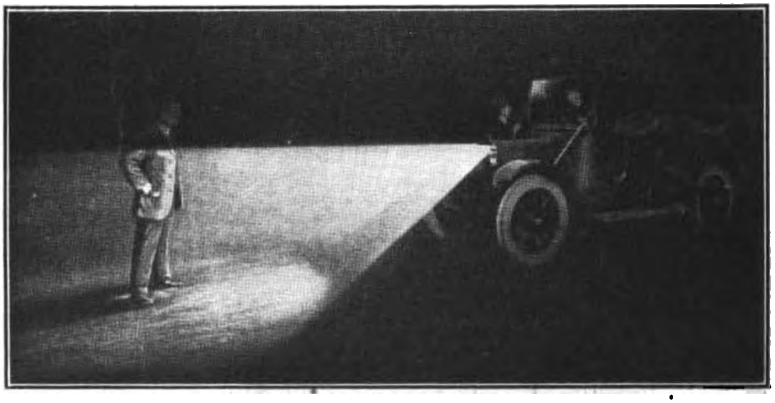

Fig. 4.

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at what position the switch may be; the turning-down feature has merely a point of current economy.

The lamp weighs about 2 pounds, and is fastened to the radiator by bolts. The aluminum brackets, being softer than the ordinary radiator metal, cause no injury.

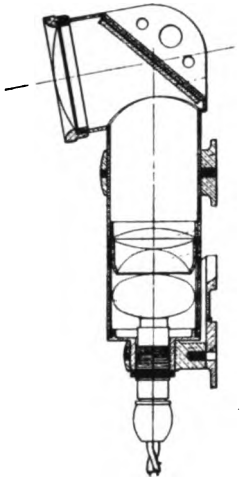

Fig. 5.

The filament in the lamp takes four amperes on a circuit of 6 to 7 volts. Above the globe are two condensing lenses. The filament lies in the center of the optical axis. The light transmitted by the lenses is projected against a French mirror located in the top of the lamp, acting as a prism, projecting the light in the direction of the focusing lens. If the light of a coil filament in any plain condensing lens system, or reflecting and condensing or parabolic reflecting system, is projected, the projected light is a glare. The light cannot be restricted within a sharply defined area, due to the physical dimensions of the filament. All the last-mentioned systems rely for light projection on the magnification of the light source. In the Roffy lamp the light transmitted by the condensing lenses is rectified to an achromatic field by a focusing lens, and by the prismatic action of the mirror between the focusing and condensing lenses the projected beam of light emerges from the device sharply defined.

Leonard Kebler—There seems to be little doubt that a majority of the accidents to motor cars are caused by the driver of the car being blinded temporarily by the exceedingly powerful headlights, whether electric or acetylene, of an approaching car, or a car standing facing the opposite direction. Steps have been taken to eliminate this dazzle in a great many cities, such as New York, Chicago, etc., by prohibiting the use of lamps which will dazzle or confuse pedestrians or drivers. As yet no steps have been taken to cover the use of such dazzling lights on the highways in the

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country or through the smaller villages. There seems to be little question in anyone's mind now that some provision must be made to take care of this. A proper device should have the following features: First, it must be possible when in the country or on untraveled roads to get the full power of the searchlight beams. Second, it must be possible when passing pedestrians or vehicles or running in the city to immediately change the character of the beams so as to make it non-dazzling, while still preserving a light which will illumine the road sufficiently for safe driving. Such light should be so diffused as to illumine the sides of the road when going around curves. Third, the change from the searchlight beam to the non-dazzling light must be made without any movement on the driver's part other than the pushing of a button or some similar motion which will not disturb his control of the car.

The Ward Leonard Electric Company has been experimenting along the lines of the above specifications for a long time, and finally at the New York show in January, 1914, showed a device practically the same as I am showing to-night, known as the Nodaz. The device consists of a series of translucent screens which normally stand parallel to the axis of the beam of light, so that they do not obstruct the light, but upon pushing a button they are electrically actuated so as to be placed at right angle to the beam of light, thus placing a curtain of translucent material between the bulb and the front of the lamp. As a result the light, instead of being condensed at one point, as is the case of the filament of an incandescent lamp bulb, becomes a plane of the size of the screen. This large plane of light gives a mellow, diffiused illumination ample for driving up to 25 miles an hour on the darkest night, and gives an exceptionally good driving light when going around curves on narrow roads or driving in the city, without in any way inconveniencing pedestrians or drivers going in the opposite direction. The operating mechanism consists of a small solenoid placed out of sight alongside of the screen.

The greatest danger due to headlights is when two cars approach an elevated bridge or a crest in the road, so as not to be visible one from the other, until they appear suddenly only a few feet apart. Any one who drives a car is familiar with such situations as this.

It does not seem sufficient to dim the light until it becomes non-dazzling, because if this is done there is not sufficient light left to illuminate the road. Similarly it is hardly sufficient to screen part of the light—that is the upper part, so that only the lower beam strikes the road, because in going over knolls, bridges, etc., as noted above, this does not eliminate the trouble.

I believe that the specifications given above are those of a good headlight device which will enable the user to drive safely in passing other cars in the country and in going about the city.

DR. WILLIAM CHURCHILL*:—One phase of the question of glare has not received the attention it deserves. As has already been remarked, a definition of glare is difficult to give. I suppose we are entitled to say roughly

*Assistant Sales Manager, Corning Glass Works.

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that any light produces glare which interferes with the acuteness of vision of adjacent objects. In that connection it is important to remember that there are several factors involved in the production of glare. One point, which is not always considered, is that whether a light is glaring depends not only on the actual candlepower and intrinsic brilliancy of the light, but also on the average candle-foot illumination of the environment. I saw that point brought out forcefully recently in connection with some work I have been doing on certain railroad signals, where it was important to use very powerful illumination for daylight indications. The same lamps that were just sufficient to give a good signal in daylight were quite dazzling in intensity at night. As twilight came on until total darkness was reached we could see the gradual increase in glare. The lights were identically the same throughout. The only changed condition in that case was the decrease in the illumination of the environment, but that change involved an effect on the pupil of the eye. Of course, as the illumination was reduced the pupil gradually opened further, so that the same light which by day was not at all glaring, by night became dazzling. It would be hard to find a better illustration of the fundamental fact that a light appears glaring only when its intrinsic brilliancy is high compared to the average illumination of the environment. Another important factor in determining glare is the apparent area of the light-emitting source; in other words, the visual angle actually covered by the light-emitting source or the area of the retina directly affected by the light in question. Of course, the larger the area the more intense the glare produced. Finally, there is a third factor that I want particularly to discuss—the quality of the light. Unless you have had occasion to look into the literature bearing on this subject you may not realize that whether a given light source produces glare depends largely on the composition of the beam—the proportions of the several spectral hues present in combination. To save a lengthy statement I want to read you a few words on that subject from an authority you will all recognize, Dr. Steinmetz, of Schenectady. I quote from "Radiation, Light and Illumination": "The light which enters the eye is converted into heat, and if its power is considerable it may be harmful or even destructive, causing inflammation or burns. This harmful effect of excessive radiation is not incident to any particular frequency, but inherent in radiation as a form of energy. It is, therefore, greatest for the same physiological effect, that is, the same amount of visibility, for those frequencies of light which have the lowest visibility or highest power equivalent, that is, for the red and the violet, and least for the green and the yellow, which for the same amount of visibility represent least power. Hence, green and greenish yellow lights are the most harmless, the least irritating to the eye, as they represent the least power."

In the same connection: "The human organism has by evolution, by natural selection, developed a protective mechanism against the entrance of radiation of excessive power into the eye; at high intensity of illumination the pupil of the eye contracts and thus reduces the amount of light admitted, and a sudden exposure to excessive radiation causes the

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eyelids to close. This protective mechanism is automatic; it is, however, responsive to long waves of radiation, to the red and the yellow light, but not to the short waves of green, blue and violet light. The reason for this is apparently that all sources of excessive radiation which are found in nature, the sun and the fire, are rich in red and yellow rays, but frequently poor in rays of short wave length."

Quoting from the Bulletin of the Bureau of Standards, Circular No. 28: "A light yellow screen is very effective in eliminating a purple haze in viewing distant objects and thus heightening contrast in an otherwise 'flat' field. The extreme contrast produced by the direct reflection of sunlight on water cannot be avoided (being nearly non-selective), but the maximum intensity may be reduced at the sacrifice of the low lights, or the glare may be 'softened' with a yellow or orange screen which eliminates the more fatiguing blue and violet."

These passages clearly indicate that in order to reduce the glare in any automobile headlight to a minimum and admittting that a rather high beam-candlepower is necessary, as we all know, for lighting up dark highways, it is highly important to provide the essential candlepower of such color as to produce the least possible amount of glare. Therefore, I ask your attention to a light yellow glass which we have developed as the result of experiments covering a period of several years, with the object of providing light of the most effective quality for headlight illumination.

The idea first occurred to me in connection with some tests of railroad headlights which I witnessed several years ago, in which all sorts of headlights were being tried out under a great variety of conditions, and when I was strongly impressed by the conclusion that the quality of the light was one of the most important factors in the problem.

There is a very great increase in intrinsic brilliancy of the light source which we are using now compared to those of a few years ago. That fact is really at the bottom of this whole question of glaring headlights.

Intrinsic Brilliancy of Sources

	C. P. per cm²
Kerosene—	
One-day	.65
Long-time	.8
Headlight	3.0
Acetylene	6.5
Mazda 25W	4
"100W conc. filament	67
Luminous arc	850
Right angle arc	2,000

Three kerosene burners are commonly used in railroad service—the old-fashioned "signal burner," what is called a long-time burner, which is of more recent development, and the headlight burner. Below them comes the acetylene flame, which is decidedly higher in brilliancy. Of course, as intrinsic brilliancy goes up the glare increases. Further down we note an ordinary incandescent lamp with open filament and also one

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with concentrated filament. The automobile lamp will not show as high intrinsic brilliancy as the 100-watt lamp, but in the small area covered by the filament comes quite close to doing so.

The "no-glare" yellow glass transmits the red, orange, yellow and green and stops just about at the commencement of the blue. I do not want to leave the impression that the red, yellow and green light cannot produce glare. Light of any color, if you have enough of it, will be glaring, but the blue and violet rays are the principal offenders and the ones which we can properly eliminate without interfering with range of vision. The total amount of red light in ordinary sources is small. The maximum intensity is in the yellow and green and a very small amount is shown in the blue and violet. I am referring to such light as the sun or light approximating it. An incandescent lamp is not greatly different, but shows relatively more yellow and less blue. The most striking characteristic of the special yellow glass is the tremendously high transmission it shows in every region of the spectrum except the blue and the violet. The ordinary yellow glass is utterly unsatisfactory and unsuitable to the purpose we are discussing now, for the reason that it absorbs a great deal too much useful light.

It may interest you to know that the application of yellow light to headlights is only one of a number that are rapidly coming to the front. For example, yellow glass, practically the same glass we have here, is now used by crack shots in making their best scores, because they find they are able to see much more distinctly with the yellow glass than they can without it.

You all know that the problem of glare is not simply a question of glare in the eyes of the other fellow coming toward your headlights or the glare that you receive from his headlights. If you happen to run into a bank of dust or fog or smoke you get a very annoying "back-glare" from your own headlights, and the higher the intensity of the headlight the worse that effect will be. It has been abundantly proven in a great variety of ways that in order to get the best penetration in smoke, dust or fog you need a yellow light. That was first demonstrated by the French navy some years ago in trials of gold-plated mirrors. Then it was found that the gold-plated mirror was not necessary at all; by simply using a yellow glass you can get even better results, provided the glass possesses the proper characteristics. The sun when rising or setting always looks reddish. There is only one explanation of that fact—as the light passes through the dust and smoke and haze of the atmosphere the blue rays are cut off, absorbed or diffused, while the red and yellow rays penetrate more easily. That illustrates in a homely way that it is the blue end of the spectrum which is mainly responsible for the diffusion and refraction which produces the annoying "back-glare" in the case of the automobile headlight. If when driving on a foggy night you can get 10 or 15 ft. more illumination ahead by eliminating a certain amount of "back-glare" it oftentimes means a great deal.

These are, in brief, the main facts I desired to illustrate, and I would ask you to bear in mind that the point which I have emphasized is the

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question of quality of light. It has nothing to do with mechanical contrivances of any sort. There are many different methods and means by which lights can be dimmed, either by using an auxiliary bulb or by using resistance or by raising or lowering the bulb, etc. But aside from all that there remains the question of the proper quality of light to use—the proper color for headlight service.

OTTO LUYTIES—The J. M. lens throws a narrow beam far ahead on the road, a sufficient beam to see quite distinctly by, and throws diffused light to either side. There is a wide arc of illumination, exceeding 180 degrees. The front of the car is plainly visible, especially the radiator and front tires.

The principal reasons the lens is not blinding are the following:

1. The central transparent portion is only about one-quarter of that of an ordinary headlight. It should be noted that size alone has a good deal to do with blinding effect. A small headlight will generally be less blinding than a large one, even if the candlepower be the same and the curvature of the reflector such that the amount of distant light projected is the same. If a pedestrian sees a bright light on the road a foot in diameter he will ordinarily be more blinded than if he sees one of only a quarter of that area. Horses are affected in the same way.

Another reason that the light is non-blinding is because it is seen against an illuminated background. You all know that the moon is less blinding when seen against a bright sky in the day time than when seen against a dark sky at night. Using this device the illuminated background provided by the frosted globe tapers off in brightness from the center to the edge. I have found by careful experiment that one of the things that causes lights to be blinding is contrast with absolute darkness. The human eye has for many generations been accustomed to see things by ordinary daylight. There is no very sharp contrast in nature except the sun itself, against which our eyelids form a certain protection.

The globe throws diffused light laterally, thereby illuminating the radiator and front wheels. If you can see the radiator and front wheels of an approaching car you do not have to stare at it for any length of time in order to make out in just what direction it is going.

The bright filament is shielded by a ground glass globe at almost all angles of observation. If you get directly in front of it there is a point at which the light will be more or less blinding. A headlight to be really non-blinding must be non-blinding in an uptilted position, as when passing over a bridge or two cars meet at the top of a hill.

The spherical frosted front has about 50 per cent. more area for light diffusion purposes than a flat front. It is possible, of course, to use a higher candlepower bulb without having too high intrinsic brilliancy per square inch.

This headlight is visible from the side, which produces a useful and attractive effect, and it remains visible for some time when passing the automobile, which is of assistance. You know that sometimes cars are sideswiped in passing on the road from crossing too soon.

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A light of this kind apparently becomes dimmed automatically when brought into a lighted city street; as any translucent frosted surface illuminated from one side becomes less bright in appearance, compared with surrounding objects, if a bright light falls upon the other side. Some of the old-fashioned photometers used to work on that principle.

It should be observed that three-quarters of all the light thrown by an automobile headlight is projected by the central portion. This is due to the fact that the central portion of a parabola is nearest to the light and situated at the most favorable angle. I do not mean the exact center, as the direct light does not amount to much, but I mean the central portion of the lens right around the bulb. That is the best part of any correct parabola, and, of course, it is nearest to the filament. The central part is the part which we conserve for distant light. Therefore, if an automobile headlight be frosted over three-quarters of its front surface the central portion of the parabola being left exposed, the greater part of the reflected light will still reach a distant object, the rest of the light being diffused in the foreground.

Slightly higher candlepower may be used with the J. M. lens if the same distant light is desired. It should be noted, however, that many of the present headlights give more distant light than is reasonably required. I think you will all agree on that. Furthermore, it should be observed that quality of light is as important as quantity, and a fairly bright, white illumination, containing a good percentage of diffused light is better to see by and less tiring to the eyes of the observer than a somewhat brighter direct light. We all know that diffused light is the best light to see by. Personally I think that white light is the best to see by. In newspaper offices they cultivate the blue rays of the spectrum. They have lights that have very much blue in them, mercury lamps, and they can see very well and pick out little details. If you have lights of very high candlepower you can dim them with some mechanical device and get very good results. But for a distant object, where the amount of light is limited, I think you do better with white light, because it makes the object stand out better, particularly against the dark, oiled roads that we have now.

A. L. McMURTRY—One of the greatest drawbacks to the early electric lamps was the fact that the engineers attached them to a car as they did the lens mirror searchlights, with little or no attention regarding the direction of the light. The small angle of light from an electric lamp as compared to the gas lamp, makes it necessary to fit the electric lamp more exactly. I think that 50 per cent. of the dazzling effect of electric headlights is due to the poor aiming of the beam of light, or defective focusing. The Locomobile company have a dark gallery into which a car is driven and the lamps properly directed and focused. The lamps are mounted on brackets heavy enough to keep them in the proper position.

We have heard about dazzling lamps, but not what causes the dazzling effect. All brilliant lamps with a dark background appear to the eye larger than they really are. The phenomenon is known as irradiation. It is due to the sympathetic action of the sensitive nerves of the retina of the eye adjoining those which actually receive the image of the lamp.

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The greater the contrast between the brilliant lamp and its surroundings, the more pronounced the irradiation.

All electric headlights use parabolic reflectors, so that the rays diverging strictly from the focus and falling on the paraboloid, emerge in one beam of parallel rays. However, as the filament of a tungsten lamp is not a mathematical point but an object of considerable magnitude, the rays from the outside being exfocal will after reflecting emerge as a cone.

Two years ago I made some tests of lamps with filaments of various forms. I found that the smallest form of filament gave the best light as far as distance was concerned, but there was very little light directly in front of the car. The average filament gives a greater angle of light, and when focused so that the light falls upon the road in front of the car, the rays are at an angle that gives the greatest dazzling effect.

I have arranged the lights on my car so that the left lamp is focused to a parallel beam and the right lamp spreads the light directly in front of the car. The right lamp is at such an angle that the light does not rise above the radiator of an approaching car. If the light of the left lamp dazzles it is turned out by a separate switch.

In regard to candlepower of tungsten lamps, there is a great difference between candlepower and intrinsic brilliancy. The former is total candlepower, while intrinsic brilliancy is really candlepower per unit of area. If you take a lamp which is burning over voltage—that is, a 5-volt lamp burning at 6 volts—you will get a high intrinsic candlepower, the intensity of which will project the light a greater distance. If, on the other hand, you use a 24-candlepower lamp burning on rated voltage, you get more light with less intrinsic value. Therefore a 24-candlepower lamp will not penetrate distance, but the larger filament, the most of which is exfocal, will give a wider beam of light, which will dazzle the driver of another car much longer than a properly focused 15-candlepower lamp

Another thing that few people properly consider is the height of the lamps from the ground. The higher the lamps are mounted the more they are directed down and the less they are apt to dazzle.

I think that the first anti-dazzling device made was the Wridgeway. It was arranged to be fitted to lens mirror searchlights. It resembled a honeycomb radiator placed in front of the lamp so that the only light projected was almost a parallel beam. The device was not a success, for the reason that it restricted the light of the lamp to which it was fitted without any relief to the owner from other dazzling lamps.

I believe there are enough different devices now on the market that legislation can require anti-dazzling lamps. Until it is passed it will be a hardship to a driver to alter his lamps in order not to dazzle the other man whose lamps dazzle.

It is interesting to see the different systems of preventing the dazzling effect of lamps, and while we are considering the adoption of any system by a manufacturer I would like to cite a little instance: Different lampmakers submitted their proposals for lamp equipment on a certain make of car. The matter was up to the purchasing agent to decide. One proposal called for a complete set of five electric lamps, with parabolic re-

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flectors and an adjustment for focusing. Another called for a fixed socket in all lamps, with parabolic reflectors in the headlights only. There was a difference of $1 in the price of the two sets, yet the cheaper and less refined set was contracted for. The point is that when a new device is submitted to manufacturers the question with most of them is cost and not efficiency.

LEONARD KEBLER—In the matter of adjusting headlights, I think it is safe to say that for the average equipment the best results are obtained by having the top of the headlights between a quarter and three-eighths of an inch further out than the bottom; in other words, the headlights tipped down to that extent. Then if the user will lay a straight-edge across the lamps and have the inside edge of each lamp a quarter or three-eighths of an inch further back than the outside he will get illumination on the sides of the road much better than if the lamps are parallel. As a rule headlights adjusted that way will give about as satisfactory results as you can get.

A. L. MCMURTRY—I would like to make a suggestion about adjusting headlights in daylight: Light the lamps and stand in front of them, keeping your eyes just outside of the beam of reflected light. In this position you will see a small area of the reflector illuminated. By moving from side to side the illuminated area can be made to move about the reflector. Find a position where the reflection is vertical. Your eye is now in the vertical plane in which lies the beam of light.

In a similar way, by lowering your eyes, while keeping at one side of the beam, the illuminated spot on the reflector may be brought into a horizontal position. The position of the eye at that instant locates the horizonal plane in which lies the beam from the lamp. The intersection of these two planes determines the direction in which the headlight is aimed.

HERBERT CHASE—It appears to me that several of the devices exhibited here this evening are inefficient from one standpoint, in that they utilize such a small amount of the light that is actually thrown from the reflector. If it is true, as one of the speakers has contended, that the blue and the violet rays are the ones that actually cause the glare or are largely responsible for it, it would seem that the logical way to reduce or eliminate the glare is to cut off those rays by some sort of screen, and then, if illumination is dimmed by that procedure to an appreciable extent, slightly increase the candlepower of the bulb. It seems to me that the logical solution of the problem is first to control the direction of the beam without cutting off any large proportion thereof, and second to change the quality of the light so that it will not be blinding when by chance it strikes the eye of a pedestrian or driver of an approaching car.

OTTO LUYTIES—A glare a foot in diameter is always a foot in diameter, no matter what color it may be. If you change the color so that it is less blinding you will also see by it to a less extent. If you feel that yellowish light of a particular type is less blinding you must also realize that it is less irritating to the eye; therefore it is less stimulating to the eye; an object having a yellow light thrown upon it will affect your eye less, and therefore be less visible.

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If you throw yellow light on a person standing on one of our brown oiled roads I think you will not see him as distinctly as you would by white light.

DR. WILLIAM CHURCHILL—It is well established by any number of authorities that the region in the spectrum where light-energy is most effective on the retina—where per unit of energy the luminosity produced is at the maximum—is in the middle of the spectrum, in the neighborhood of the yellow and the green, and obviously luminosity falls off at the two extremes of the spectrum. In other words, an infinite amount of infra-red or ultra-violet could not produce vision.

In this connection an instance occurred to me during the discussion that may be worth mentioning, as it brings out the relative advantage of light of different qualities. In a very large establishment there was a great deal of complaint by some of the clerks who were obliged to do much reading and writing at night under bluish light. A careful investigation was conducted by one of the highest authorities in this country to determine whether there was any ground for the complaint. It was definitely established as the result of the investigation that the clerks who were using chiefly white paper, and thus getting a relatively large percentage of the blue and violet rays, were the only ones whose eyesight was affected, while the clerks who used chiefly yellowish paper, which reduced the proportion of blue and violet light reflected were apparently free from bad effects.

Mr. McMurtry referred to the difficulty of getting the individual to put on a device which will reduce glare because although it might help a man's neighbor, it is not going to help him very much. He should be taught that if he equips himself with a yellow light of effective quality he is going to be distinctly better off in fog and smoke himself, as well as furnishing a light that is more satisfactory to the other man; and if his neighbors and friends are not sufficiently generous to equip their cars with devices that reduce the glare, he can take refuge in the use of a small yellow windshield, which will eliminate all the serious glare of any headlights he may encounter. I mean a small disc fastened to the windshield or steering post.

One other point that I think ought to be emphasized is that, so far as possible, in the effort to eliminate dazzling headlights and to solve the headlight problem, we ought to try to avoid complications of one sort or another that will require constant attention from the operator of the car. If the device needs to be turned on and off at frequent intervals it is not going to be used. If a man has to keep pressing buttons or turning switches on some such device all the time it is going to require a great deal of his attention. Therefore, it would seem desirable to work the problem out as far as possible along lines which will require the minimum of attention from the operator of the car.

HERBERT CHASE—I would like to ask Dr. Churchill what his opinion is as to the visibility of objects with a yellow light, and also if he will say a word about the recent investigation conducted by, I believe, the

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Master Mechanics' Association regarding the locomotive headlight, which has some bearing on this subject?

DR. WILLIAM CHURCHILL—To answer briefly the question regarding the visibility of objects, the special yellow glass cuts out, by photometric measurement, approximately 15 per cent. of the total amount of light. In that connection bear in mind that the range of a headlight varies as the fourth root of the intensity of the beam, so that a diminution of 15 per cent. of the total amount of light would not reduce the range very much if other condititons were equal. As a matter of fact you increase the range of vision because you cut out to a large extent the effects of haze, fog, smoke or dust; you gain more in that way than you lose by the reduction of intensity. As I mentioned early in the evening, it has been demonstrated by those who are better able to prove the point than I am, in the army and navy, where marksmanship requires the best possible acuity of vision, that yellow glass gives increased acuity and that the amount of light absorbed is far more than offset by the advantage gained otherwise.

In reference to the other point, that is really too long a matter to discuss this evening, but just to show how much has been done on the subject here is a volume of 330 pages covering a report presented at the American Railway Master Mechanics' Association several weeks ago at Atlantic City, involving an investigation that lasted three or four years on the whole subject of headlights as it applies to locomotives on steam roads. They have tested out all sorts of headlights and give groups of photometric curves and actual service tests, tests to determine whether the observation of signals was interfered with by the use of headlights. To sum up their very thorough work in a few words, they reached the conclusion that in steam railroad practice the maximum headlight illumination that should be permitted from the point of view of good service, the maximum which they felt it was safe to allow without interfering with the observation of landmarks and signals and without producing glare in the eye of the engineer coming in the opposite direction, was a beam of 3,000 equivalent candlepower, with a minimum of 500 equivalent candlepower.

Something was said awhile ago about the size of the reflector being the chief factor in determining glare. That statement probably requires qualification. The amount of glare depends, of course, partly on the size of the reflector, but it depends primarily on the intrinsic brilliancy of the source of light. To mention an illustration in point, an oil headlight burner such as is recommended in these reports has an intrinsic brilliancy, as I mentioned earlier in the evening, of about three candlepower per square centimeter. The reflector usually measures about eighteen inches in diameter. The total candlepower of the beam is possibly 3,000. Now if you were to set in that reflector the concentrated filament of an incandescent lamp you would get a very different result. Instead of using, as they do in a locomotive headlight, a thirty- or forty-candlepower lamp, you might use only a five-candlepower concentrated filament lamp, but you would get a much more glaring light, on account of the concentration of the filament.

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The conditions which are met with in steam railroad service are different from those which are encountered in driving an automobile, and the chances are that what is sufficient illumination on the steam road would hardly be enough in automobile headlight service. But any of you who are interested in this question of headlights would, I think, find it worth while to look over the data in this report, which is undoubtedly the most exhaustive study of the subject of headlights that has ever been made in this country.

CO-OPERATION BETWEEN ENGINE BUILDERS AND S. A. E.

The Automobile Engine Manufacturers' Association recently passed resolutions as to motor standards, as follows:

"First.—That the present S. A. E. motor standards, as designated below, shall be adopted as the motor standards of this Association.

"Second.—That we request the Standards Committee of the S. A. E. not to pass upon the standardization of any parts concerned in motor building without concurrence on the part of the Standards Committee of this Association.

"Third.—That this Association establish no motor standards without the concurrence of the Standards Committee of the S. A. E.

"The following are the standards of the S. A. E. on motor parts to date:

	Volume.	Sheets.
Screw standards	I	4, 4A
Spark plug steel	I	3
Iron and steel specifications	I	9, to 9c
Aluminum and copper alloys	I	13
Seamless steel tubing	I	16
Lock washers	I	5
Oversizes of engine pistons and cylinders	I	47
Gear-shift gates	I	46 — 46b
Motor test sheet forms	III	
Carbureter fittings	I	35, 35a
Lighting and starting storage battery instructions	I	48 — 48b
Magneto dimensions	I	36
Taper fittings	I	7a
Six-spline fittings	I	7b, 7c
Ten-spline fittings	I	7b, 7c
Square broached fittings	I	7
Ball bearings	I	29 to 29c
Steel bands and strips	I	8a
Brass rods	I	13a
Brass sheets and strips	I	13b
Dimensions of mechanically-driven air pumps	I	26a

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"The following also are under consideration by the S. A. E. Committee at the present time and will be taken up by our committee immediately, so as to be ready to consider the recommendations of the S. A. E. committee:

Further elements of ball and roller bearings.
Four-spline fittings.
Powerplant equipment for motor trucks.
Physical properties of heat treated S. A. E. steels.
Proper drill sizes for tapped holes.
Elements of electric lighting and starting systems.
Formulation of scientific motor tests.
Lubricating oils and greases.
Horsepower formula.
Extension of screw standard to larger dimensions."

The S. A. E. Council recently created the Standards Exchange Division defining its scope of work for the present as being to keep in touch with all Standards Committee actions on parts, materials, accessories and practices affecting the design and construction of internal combustion motors, and to co-operate with the Automobile Engine Manufacturers' Association. The following constitute the S. A. E. Standards Exchange Division:

G. G. Behn, Chief Engineer, Hudson Motor Car Company.
W. H. Conant, Detroit Manager, Gould Storage Battery Co.
W. A. Fredericks, Chief Engineer, Continental Motor Mfg. Co.
E. R. Fried, Engineer, Ferro Machine & Foundry Co.
V. W. Kliesrath, Chief Engineer, Bosch Magneto Co.
A. F. Knobloch, Manufacturing Engineer, Northway Motor Mfg. Co.
W. T. Norton, Jr., Chief Engineer, Selden Motor Vehicle Co.
C. B. Rose, Chief Engineer, Velie Motor Vehicle Co.
K. W. Zimmerschied, Chief Metallurgist, General Motors Co.

MEMBERS ELECTED JULY 15

MEMBERS

Pilkington, Robert G., 712 Michigan Blvd. Bldg., Chicago, Ill.
Roesch, Daniel, Armour Institute of Technology, Chicago, Ill.
Willard, Walter C., 2259 Oakdale Ave., Chicago, Ill.

ASSOCIATES

Botts, Alexander J., 2603 Edgar St., Carrick, Pa.
Costello, Chas. M. A., C. Cowles & Co., New Haven, Conn.
Rockwood, Wm. M., Box 636, Indianapolis, Ind.
Romeyn, Radcliffe, American Malleables Co., Owosso, Mich.
Wilson, O. P., Norma Co. of America, 1790 Broadway, New York City.

JUNIOR

Wiggers, John, 605 Plymouth St., Los Angeles, Cal.

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TRANS-ATLANTIC FLYING BOAT AMERICA

At the summer meeting of the Society, upon motion of Mr. Joseph A. Steinmetz, a message was sent to the Aero Club of America, extending greetings to Lord Northcliffe, the sponsor; Rodman Wanamaker, the patron; Glenn Curtis, the builder and Lieut. Porte and his mate, the navigators of the First Trans-Atlantic Flying Boat *America*.

The message was acknowledged by the following letter:

Society Automobile Engineers,
Mr. Coker F. Clarkson, 1790 Broadway, City.

DEAR MR. CLARKSON: The cordial greetings extended by our friends of the Society of Automobile Engineers, sent us by telegram from Cape May, June 25th, was duly received and we assure you all of our sincere appreciation of your good wishes for the success of the Trans-Atlantic Air Boat Flight.

There exists such a close kinship between engineers of the high-power motor forces on land and sea and the navigators of the air and builders of the flying craft, that we again wish to assure you of our appreciation of the cordial relations thus established between the Society of Automobile Engineers and the Aero Club of America with scores of affiliated clubs in this country and abroad.

We recognize we owe much to the tremendous development of the automobile industry and particularly to the work that you have done, and are doing, and will do, in the development of the gasoline engine, the investigation and perfecting of the fuels and materials of construction; that it is logical that we should look to your splendid body of trained engineers for new developments in America of such importance that they will lead us to further conquests of the air.

Therefore we voice for our Board of Governors and membership of our Club, our sincere thanks for your kind well wishes for the successful Trans-Atlantic voyage of the flying boat *America*.

We are also pleased to thank you in the name of Lord Northcliffe, the sponsor; Mr. Rodman Wanamaker, the donor; and Lieut. J. C. Porte and his assistants, the navigators.

We will be pleased if you will convey to your membership, through your regularly issued "Bulletin" a copy of this letter, so that they may know individually and collectively that we will always be glad to assist in any way we can, the work you are doing and to receive from you and your members the help and assistance you have always so willingly rendered, and which we know will bring to America the honor and distinction of further advancements in the aeronautical art.

Yours very truly,
AERO CLUB OF AMERICA.

(Signed)
HOWARD HUNTINGTON, Secretary.

ATHLETIC EVENTS AT SUMMER MEETING

Not the least interesting or well-attended feature of the Summer Meeting was the athletic carnival conducted by F. E. Moskovics, Chairman of Sports. John C. Wetmore, dean of automobile editors, was master of ceremonies, and Alfred Reeves clocked the events.

The fun was fast and furious during the afternoon of the last day of the meeting.

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All-Round Championship

J. E. Schipper won the all-round championship, with 13 points, S. D. Murfey being second with 11½ points.

The winners in the various contests were:

100-YARD DASH

First.....D. R. Swinton
Second.....L. P. Jones
Third.....S. D. Murfey

BROAD JUMP

First.....J. E. Schipper
Second.....V. W. Kliesrath
Third.....S. D. Murfey, L. P. Jones

BASE RUNNING

First.....S. D. Murfey
Second.....J. E. Schipper
Third.....L. P. Jones

HAMMER THROW

First.....Frank M. Martin
Second.....David Beecroft
Third.....A. B. Cumner

SWIMMING RACE

First.....S. D. Murfey
Second.....J. E. Schipper
Third.....L. P. Jones

FAT MEN'S RACE

First.....Frank M. Martin
Second.....Berne Nadall
Third.....John G. Utz

BASEBALL GAME WON BY THE INDIANS

The Indians won the baseball game from the Metropolitans, 12 to 5.

As Mr. Schipper said at the time the prizes were awarded by Commodore Wetmore, the all-round championship happily went to the Metropolitan Section, although the ball game *was* "framed up."

TENNIS TOURNAMENT

Owing to the many entries, it was impossible to finish the tennis tournament, in which Herbert Chase, David Beecroft, J. E. Schipper and W. M. Noyes still survive to play off matches as soon as the same can be arranged; Frank S. Slocum, D. J. Burns, F. W. Galbraith, C. F. Clarkson, H. E. Coffin, R. H. Combs, B. B. Bachman, John Wilkinson, Henry Souther, John R. Cautley, N. A. Wolcott having fallen by the wayside as a result of encountering too superior skill.

D. W. Sowers, Walter C. Allen, Joseph Bijur were obliged to default their matches.

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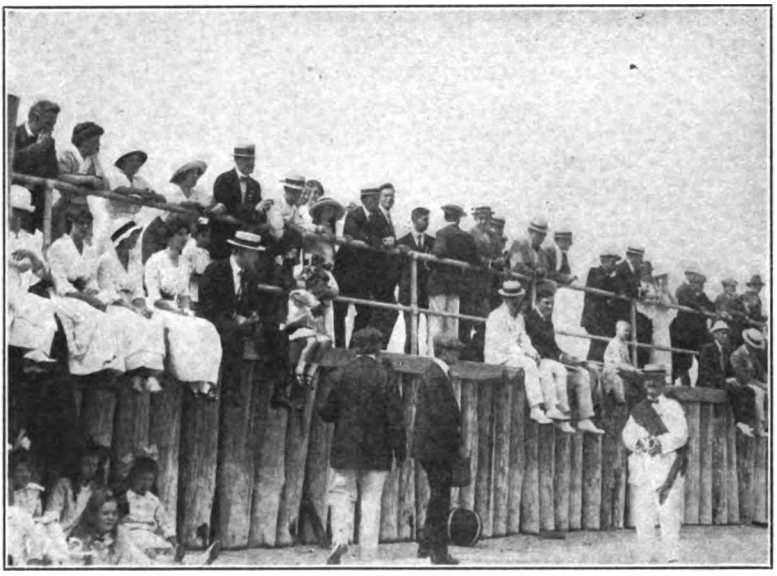

Watching the Athletic Events.

Herbert Chase as Miss Cyclecine Bloomerstripe, Witness in the Mock Trial of the Metropolitan Section.

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Summer Meeting

Tribe of Indiana (?) Indians.

Detroit Section Ideal Car.

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REGISTRATION LIST OF SUMMER MEETING

Adams, Charles E., Cleveland Hardware Co., Cleveland, Ohio.
Allen, C. Louis, Pyrene Mfg. Co., New York City.
Allen, Harry, Field Omnibus Co., New York City.
Allen, R. S.
Allen, Walter C., Bijur Motor Lighting Co., Hoboken, N. J.
Amos, Chas. L., Dyneto Electric Co., Syracuse, N. Y.
Anglada, Joseph A., New York City.
Apple, V. G., Apple Electric Co., Dayton, Ohio.
Applegate, C. W.
Armstrong, J. R. C., General Vehicle Co., Long Island City, N. Y.
Arndts, E. C., Cleveland-Canton Spring Co., Canton, Ohio.
Atwell, Joseph, Michelin Tire Co., Milltown, N. J.

Babson, R. D., Bausch Machine Tool Co., Springfield, Mass.
Bachman, B. B., The Autocar Co., Ardmore, Pa.
Baker, Walter C., Cleveland, Ohio.
Barker, P. H.
Barter, P. L., McCord Mfg. Co., Detroit, Mich.
Bate, John W., Mitchell-Lewis Motor Co., Racine, Wis.
Baumgartner, Walter J., Sheldon Axle Co., Wilkes-Barre, Pa.
Beecroft, David, *Class Journal Co.*, New York City.
Beemer, Frank, Philadelphia, Pa.
Bell, John, Marburg Bros. Inc., New York City.
Bell, Norman, The Lunkenheimer Co., Cincinnati, Ohio.
Benton, J. C.
Bergmann, A. C., Mercer Automobile Co., Trenton, N. J.
Bigelow, Fred A., Carpenter Steel Co., Reading, Pa.
Bijur, Joseph, Bijur Motor Lighting Co., Hoboken, N. J.
Black, T. J., Cleveland Hardware Co., Cleveland, Ohio.
Blanchard, F. C.
Bouggy, C. M., J. S. Bretz Co., New York City.
Bowers, Lee S., Schwarz Wheel Co., Philadelphia, Pa.
Bristol, A. E.
Broege, R. J., Buda Co., Harvey, Ill.
Brown, A. M.
Browne, Arthur B., Branford, Conn.
Brush, A. P., A. P. Brush Engineering Association, Detroit, Mich.
Bryant, Richard S., Standard Welding Co., Cleveland, Ohio.
Buckwalter, T. V., Pennsylvania Railroad, Altoona, Pa.
Bugie, Henry A., Heller Bros. Co., Newark, N. J.
Burgess, Frank, Boston Gear Works, Norfolk Downs, Mass.
Burns, D. J., Ward Leonard Electric Co., Bronxville, N. Y.
Burton, J. C., *Motor Age*, Chicago, Ill.
Buzby, Arthur D., New York City.
Buzby, H. S.

Carlton, C. C., Firestone Tire & Rubber Co., Akron, Ohio.
Cautley, John R., Peter A. Frasse & Co., Inc., New York City.
Chase, Herbert, Automobile Club of America, New York City.
Chevraux, Charles A., Cleveland, Canton Spring Co., Canton, Ohio.
Church, W. M.
Clarke, John S., The Autocar Co., Ardmore, Pa.
Clarke, Louis S., The Autocar Co., Ardmore, Pa.
Clarkson, Coker F., New York City.
Clemens, Chester E., Perfection Spring Co., Cleveland, Ohio.
Clingan, R. E., Hess-Bright Mfg. Co., Philadelphia, Pa.
Coffin, Howard E., Hudson Motor Car Co., Detroit, Mich.

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Combs, R. H., The Prest-o-lite Co., Indianapolis, Ind.
Conant, W. H., Gould Storage Battery Co., Detroit, Mich.
Connell, Herbert L., Detroit, Michigan.
Conrad, Frank, Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.
Coolican, Oscar, Dayton Engr. Lab. Co., Dayton, O.
Cramp, C. D., Wm. Cramp & Sons S. & E. B. Co., Philadelphia, Pa.
Crawford, Charles S., Cole Motor Car Co., Indianapolis, Ind.
Culver, W. P., Culver-Taylor Chain Works, Detroit, Mich.
Cumner, Arthur B., New York City.
Cunningham, Dr. R. H., Splitdorf Electrical Co., Newark, N. J.

Davis, Charles Ethan, New York City.
DeCampi, E. A., National Lead Co., Chicago, Ill.
Dexter, R. E., Midvale Steel Co., Philadelphia, Pa.
Donahue, James E., Russell, Burdsall & Ward Nut & Bolt Co., Chicago, Ill.
Dusinberre, S. B., New Departure Mfg. Co., Detroit, Mich.

Ehle, A. H., Baldwin Locomotive Works, Philadelphia, Pa.
Ehrman, E. H., Chicago Screw Co., Chicago, Ill.
Eilert, W. K., Willard Storage Battery Co., Cleveland, Ohio.
Entz, Justus B., The White Co., Cleveland, Ohio.

Fend, R. S., Woods Motor Vehicle Co., Chicago, Ill.
Fergusson, David, Pierce Arrow Motor Car Co., Buffalo, N. Y.
Fijur, Louis B., Willard Storage Battery Co., Cleveland, O.
Firestone, R. J., Firestone Tire & Rubber Co., Akron, O.
Fitzpatrick, Clarence J., Cleveland Worm & Gear Co., Cleveland, Ohio.
Fitzpatrick, David, Cleveland Worm & Gear Co., Cleveland, O.
Flannery, H. J., American Vanadium Co., Pittsburgh, Pa.
Foljambe, E. S., *The Chilton Co.*, Philadelphia, Pa.
Ford, Bruce, Electric Storage Battery Co., Philadelphia, Pa.
Formigle, Otto L., Sheldon Axle Co., Wilkes-Barre, Pa.
Fretz, E. S., Light Mfg. Foundry Co., Pottstown, Pa.
Friend, O. C., Mitchell-Lewis Motor Co., Racine, Wis.

Galbraith, Frederic W., Jr., George Automatic Roller Bearing Co., Cincinnati, Ohio.
Gardner, Howard S., Willard Storage Battery Co., Chicago, Ill.
Germane, Frank M., Standard Roller Bearing Co., Philadelphia, Pa.
George, I. A., George Roller Bearing Co., Hamilton, Ohio.
Gibbon, P. H.
Gill, H. M.
Girl, Christian, Perfection Spring Co., Cleveland, Ohio.
Griswold, Roger W., The Cutler-Hammer Mfg. Co., Milwaukee, Wis.
Gurnett, C. H., *Class Journal Co.*, Chicago, Ill.

Halbleib, Joseph C., North East Electric Co., Rochester, N. Y.
Hale, James E., Goodyear Tire & Rubber Co., Akron, Ohio.
Hall, Edwin R., Goodyear Tire & Rubber Co., Akron, Ohio.
Hankey, W. G.
Hanna, G. M.
Harfst, R. G., Cadillac Motor Car Co., Detroit, Mich.
Harris, R. G.
Harris, H. E., Greenfield Tap & Die Co., Greenfield, Mass.
Hatch, C. W., Perfection Spring Co., Cleveland, Ohio.
Hawley, W. G., American LaFrance Fire Engine Co., Elmira, N. Y.
Heinze, John O., Heinze Electric Co., Detroit, Mich.
Heldt, P. M., *The Horseless Age*, New York City.

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Heller, Thomas J., Atlas Ball Co., Philadelphia, Pa.
Herst, Ward F., Brown-Lipe Gear Co., Syracuse, N. Y.
Hess, H. Lawrence, Hess Steel Castings Co., Bridgeton, N. J.
Hess, Henry, Hess Steel Castings Co., Philadelphia, Pa
Hinkley, C. C., Chalmers Motor Co., Detroit, Mich.
Holcomb, J. R., Midvale Steel Co., Philadelphia, Pa.
Hoopes, Russell, Hoopes Bros. & Darlington, Inc., West Chester, Pa.
Houk, George W., Buffalo, N. Y.
Hoyt, H. J., Morgan & Wright, Detroit, Mich.
Huff, Russell, Packard Motor Car Co., Detroit, Mich.
Hughes, F. G., New Departure Mfg. Co., Bristol, Conn.

Janney, J. A., Janney Steinmetz & Co., Philadelphia, Pa.
Jarosch, Franz J., J. S. Bretz Co., New York City.
Jenkins, S. S., Willard Storage Battery Co., Cleveland, O.
Jennings, John J., New Departure Mfg. Co., Bristol, Conn.
Jones, Lloyd P., American Bronze Co., Detroit, Mich.

Kelly, Arthur, Red Bank, N. J.
Kempter, Philip, Paeschke & Fret Co., Milwaukee, Wis.
Kendrick, W. S., General Electric Co., Schenectady, N. Y.
Kent, A. A., Atwater Kent Mfg. Works, Philadelphia, Pa.
Klander, P. H.
Kliesrath, V. W., Bosch Magneto Co., New York City.
Kuhn, I. A., Willard Storage Battery Co., Cleveland, Ohio.

Lacy, Volney E., James Cunningham Son & Co., Rochester, N. Y.
Lane, Ralph S., Hyatt Roller Bearing Co., Newark, N. J.
Laycock, Arthur M., Sheldon Axle Co., Wilkes-Barre, Pa.
Leland, Henry M., Cadillac Motor Car Co., Detroit, Mich.
Libby, Albion D., Splitdorf Electrical Co., Newark, N. J.
Lipman, Carl E. L., Lipman Mfg. Co., Beloit, Wis.
Lloyd, Robt. McA., New York City.
Longwell, Henry E., Westinghouse Air Spring Co., E. Pittsburgh, Pa.
Lynch, E. G.
Lyon, G. Albert, Lyon Non-Skid Co., Philadelphia, Pa.
Lyons, James W., Lyons Atlas Co., Indianapolis, Ind.

McKinley, C. W., Willys Overland Co., Toledo, O.
McMinn, Stanley P., *Motor World Publishing Co.*, New York City.
McMurtry, Alden L., Sound Beach, Conn.
Manson, Ray H., The Garford Mfg. Co., Elyria, Ohio.
Marburg, Theo. H., Marburg Bros., Inc., New York City.
Markland, Geo. L., Jr., Philadelphia Gear Works, Philadelphia, Pa.
Martin, Fred L., Sheldon Axle Co., Wilkes-Barre, Pa.
Martin, F. H., Stewart Warner Speedometer Corp., New York City.
Mathews, John A., Halcomb Steel Co., Syracuse, N. Y.
Mattson, S. Hewes, Janney, Steinmetz & Co., Philadelphia, Pa.
Maynard, F.
Merkel, J. F., Middletown, Ohio.
Meyers, C. L.
Milton, Taliaferro, Electric Storage Battery Co., Philadelphia, Pa.
Moore, T. J., Halcomb Steel Co., Philadelphia, Pa.
Moskovics, F. E., Nordyke & Marmon Co., Indianapolis, Ind.
Motsinger, H. N., Motsinger Device Mfg. Co., Lafayette, Ind.
Murfey, S. D., Grant Lees Gear Co., Cleveland, O.
Murray, C. E., Willard Storage Battery Co., Cleveland, Ohio.
Myers, Cornelius T., Detroit, Mich.

Nadall, Berne, Stewart & Warner Speedometer Corp., Chicago, Ill.
Newkirk, Walter M., Wm. & Harvey Rowland, Inc., Philadelphia, Pa.

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Nichols, L. C., Allis Chalmers Mfg. Co., Norwood, Ohio.
Nightingale, R. J., Willard Storage Battery Co., Cleveland, Ohio.
Nones, Walter M., Norma Co., of America, New York City.
Norton, Walter W., Autocar Co., Ardmore, Pa.
Norton, Wm. T., Jr., Selden Motor Vehicle Co., Rochester, N. Y.

Oberly, H. E., Jos. T. Ryerson & Son, Chicago, Ill.
Oglebay, Crispin, Ferro Machine & Foundry Co., Cleveland, O.
Oleitz, H. E.
Olsen, Thorsten Y., Tinius Olsen Testing Machine Co., Philadelphia, Pa.
Osburn, Harry G., National Metal Molding Co., Economy, Pa.
Owen, Ralph R., C. A. Mezger, Inc., New York City.
Owen, R. M., R. M. Owen Co., New York City.

Page, DeWitt, New Departure Mfg. Co., Bristol, Conn.
Palmer, Wm. H., Jr., Electric Storage Battery Co., Philadelphia, Pa.
Parker, J. H., Carpenter Steel Co., Reading, Pa.
Parker, Orrel A., Newmastic Co., New York City.
Payne, Willard Marsh, Ferguson Publishing Co., New York City.
Peck, E. C., Cleveland Twist Drill Co., Cleveland, Ohio.
Perrin, J. G., Lozier Motor Co., Detroit, Mich.
Peterson, Gustaf, Carnegie Steel Co., Pittsburgh, Pa.
Phillips, F. F., New York City.
Pickup, W. B., Positive Lock Washer Co., Newark, N. J.
Pierson, F. B., National Lead Co., Detroit, Mich.
Pike, F. M., National Carbon Co., Cleveland, O.
Polson, W. F., Polson Mfg. Co., Buffalo, N. Y.
Poole, Alfred J., Bosch Magneto Co., New York City.
Pope, N. B., *Motor Trades* Publishing Co., New York City.
Potter, Austin E., Brooklyn, N. Y.
Pringle, Nelson S., The Autocar Co., Ardmore, Pa.
Pruhl, Paul.

Ralph, W. J., *Class Journal Co.*, New York City.
Reeves, Alfred, National Automobile Chamber of Commerce, New York City.
Roberts, W. H., Department of Finance, New York City.
Ross, Edward J., Jr., Edison Storage Battery Co., Orange, N. J.
Ross, William James, Ross Motor Car Co., Ltd., Toronto, Canada.
Rowland, Edward K., William & Harvey Rowland, Inc., Philadelphia, Pa.
Rumney, Mason P., Detroit Steel Products Co., Detroit, Mich.
Russell, R. F., Bessemer Motor Truck Co., Grove City, Pa.
Rys, C. F. W., Carnegie Steel Co., Pittsburgh, Pa.

Sayre, Fred S., Positive Lock Washer Co., Newark, N. J.
Schipper, J. Edward, *The Class Journal Co.*, New York City.
Schneider, John S., The Bossert Co., Utica, N. Y.
Schneider, Louis J., Hyatt Roller Bearing Co., Detroit, Mich.
Schwarz, Charles L., Schwarz Spring Co., Philadelphia, Pa.
Schwarzkopf, E. E., Gray & Davis, Inc., New York City.
Sevin, Harry L., Whitney Mfg. Co., Hartford, Conn.
Shailer, Robert A., Fahrig Metal Co., New York City.
Shepard, Stuart Roy, Rhineland Machine Works, New York City.
Slocum, Frank S., Jones & Laughlin Steel Co., Pittsburgh, Pa.
Snyder, C. O., Arbenz Car Co., Chillicothe, Ohio.
Snyder, W. A.
Soules, D. W.
Souther, Henry, Ferro Machine & Foundry Co., Cleveland, Ohio.
Sowers, D. W., Sowers Mfg. Co., Buffalo, N. Y.
Spencer, Leslie V., *Class Journal Co.*, Detroit, Mich.
Spicer, C. W., Spicer Mfg. Co., Plainfield, N. J.

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Splitdorf, Charles F., New York City.
Spooner, F. E., Spooner & Wells, Detroit, Mich.
Stafford, Samuel G., Vulcan Crucible Steel Co., Aliquippa, Pa.
Stark, J. W., DuPont Fabrikoid Co., Wilmington, Del.
Stehn, O. P.
Steinmetz, Joseph A., Janney Steinmetz & Co., Philadelphia, Pa.
Stevens, Albert I., N. Z. Graves Co., Inc., Philadelphia, Pa.
Strong, Arthur J., The Bock Bearing Co., Toledo, Ohio.
Stuart, Harve R., Robbins & Myers Co., Springfield, Ohio.
Suplee, H. H., New York City.
Swartley, W. C., Tioga Steel & Iron Co., Philadelphia, Pa.
Sweet, Ernest E., Cadillac Motor Car Co., Detroit, Mich.
Swetland, H. M., *Class Journal Co.*, New York City.
Swinton, D. R., Tuthill Spring Co., Chicago, Ill.

Thoms, Max H., Nordyke & Marmon Co., Indianapolis, Ind.
Thomson, Arthur G., Joseph Dixon Crucible Co., Jersey City, N. J.
Tibbetts, Milton, Packard Motor Car Co., Detroit, Mich.
Tice, P. S., Holley Bros. Co., Detroit, Mich.
Totman, W. W., The Whitney Co., Hartford, Conn.
Towle, Herbert L., Philadelphia, Pa.
Trabold, Frank W., J. H. Williams & Co., Brooklyn, N. Y.
Tucker, F. E.

Underhill, R. K.
Utz, J. G., Perfection Spring Co., Cleveland, Ohio.

Vail, E. L., Waltham Watch Co., Waltham, Mass.
VanSickle, C. S.
Villiers, S. H.
Vilmar, Fred W., Parish & Bingham Co., Cleveland, Ohio.
Wagner, W. J.
Wall, William Guy, National Motor Vehicle Co., Indianapolis, Ind.
Walton, W. R.
Waterman, Arthur, Hartford Suspension Co., Jersey City, N. J.
Watson, John W., American Bronze Co., Berwyn, Pa.
Welch, Clarence J., United States Tire Co., New York City.
Welfare, Harry G., National Carbon Co., Cleveland, Ohio.
Wells, Frank O., Wells Bros. Co., Greenfield, Mass.
Wetmore, J. C., *The Evening Mail*, New York City.
Wilkinson, John, H. H. Franklin Mfg. Co., Syracuse, N. Y.
Williams, Clarence B., The Mott Wheel Co., Utica, N. Y.
Williams, Louis W., Union Drawn Steel Co., New York City.
Wilson, Henry C., New York City.
Wilson, M. W. H., Cadillac Motor Car Co., Detroit, Mich.
Wolcott, N. A., Packard Electric Co., Warren, Ohio.

Young, C. H., Armstrong Cork & Insulating Co., Pittsburgh, Pa.
Young, J. A.
Yuster, M. L., Yuster Axle Co., Cleveland, Ohio.

Zimmerschied, K. W., General Motors Co., Detroit, Mich.

LADIES.

Adams, Mrs. Charles E., Cleveland, Ohio.
Amos, Mrs. C. L., Syracuse, N. Y.
Applegate, Mrs. C. W.
Arndts, Mrs. C. E., Canton, Ohio.

Babson, Mrs. R D., Springfield, Mass.
Beecroft, Mrs. David, New York City.

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Bowers, Mrs. L. S., Philadelphia, Pa.
Bristol, Mrs. A. E.
Browne, Mrs. Arthur B., Branford, Conn.
Brush, Mrs. A. P., Detroit, Mich.
Burgess, Mrs, Frank, Norfolk Downs, Mass.

Clarkson, Mrs. Coker F., Tarrytown, N. Y.
Clemens, Mrs. C. E., Cleveland, Ohio.
Clingan, Mrs. R. E., Cleveland, Ohio.
Coffin, Mrs. Howard E., Detroit, Mich.
Combs, Mrs. R. H., Indianapolis, Ind.
Conant, Mrs. W. H., Detroit, Mich.

Ehle, Mrs. A. H., Philadelphia, Pa.

Fergusson, Mrs. David, Buffalo, N. Y.

Germane, Mrs. F. M., Philadelphia, Pa.
Girl, Mrs. Christian, Cleveland, Ohio.

Herst, Mrs. W. F., Syracuse, N. Y.

Kempter, Mrs. P., Milwaukee, Wis.
Kliesrath, Mrs. V. W., New York City.

Laycock, Mrs. A. M., Wilkes-Barre, Pa.
Libby, Mrs. A. D., Newark, N. J.

Manson, Mrs. R. H., Elyria, Ohio.
Martin, Mrs. F. L., Wilkes-Barre, Pa.
Martin, Mrs. F. W.
Moore, Mrs. T. J., Philadelphia, Pa.

Nones, Mrs. W. M., New York City.

Olsen, Mrs. T. J., Philadelphia, Pa.

Page, Mrs. DeWitt, Bristol, Conn.
Parker, Mrs. Orrel A., New York City.
Peck, Mrs. E. C., Cleveland, Ohio.
Poole, Mrs. A. J., New York City.
Pope, Mrs. N. B., New York City.

Reeves, Mrs. A., New York City.

Schipper, Mrs. J. E., New York City.
Schneider, Mrs. J. S., Utica, N. Y.
Schwartzkopf, Mrs. E. E., New York City.
Slocum, Mrs. F. S., Pittsburgh, Pa.
Souther, Mrs. Henry, Cleveland, Ohio.
Spicer, Mrs. C. W., Plainfield, N. J.
Spooner, Mrs. F. E., Detroit, Mich.
Stafford, Mrs. S. G., Aliquippa, Pa.
Sweet, Mrs. E. E., Detroit, Mich.

Thompson, Mrs. A., Jersey City, N. J.
Tice, Mrs. P. S., Detroit, Mich.

Wilkinson, Mrs. John, Syracuse, N. Y.
Williams, Mrs. C. B., Utica, N. Y.
Wilson, Mrs. Henry, New York City.
Wilson, Mrs. M. W., Detroit, Mich.

Young, Mrs. J. A.

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CHANGES OF ADDRESS OF S. A. E MEMBERS

Gaidzik, G. W., now connected with Morris Russel & Co., Ltd., London, E. C., England.

Garland, Ralph C., formerly with Martin Tractor Co., Springfield, Mass.; now in engineering laboratories, Briscoe Motor Co., Jackson, Mich.

Kimball, A. L., formerly research engineer, Chalmers Motor Co., Detroit, Mich.; now experimental engineer, Hudson Motor Car Co., Detroit, Mich.

Mertz, Frederick P., formerly chief draftsman, Henderson Motor Car Co., Indianapolis, Ind.; now general manager, Comet Cyclecar Co., Indianapolis, Ind.

Reed, W. S., formerly chief engineer, Norwalk Motor Car Co., Martinsburg, W. V.; now chief engineer, Cowles-MacDowel Engineering Co., Chicago, Ill.

Richter, Edwin E., formerly traveling sales manager, Dorris Motor Car Co., St. Louis, Mo.; now with Champion Motor Car Co., St. Louis, Mo.

Rueger, Wm. J., formerly vice-president, Oscar C. Olt Co., Dayton, Ohio; now with Chalmers Motor Co., Detroit, Mich.

Schaefer, C. T., formerly chief engineer, Mogul Motor Truck Co., St. Louis, Mo.; now in engineering department, Champion Motor Car Co., St. Louis, Mo.

Simonds, J. E., now designer, Hurlburt Motor Truck Co., New York City.

Stoops, Harry J., formerly vice-president and general manager, American Cyclecar Co., Bridgeport, Conn.; now with American Pin Co., Waterbury, Conn.

Whitworth, Stanley, formerly superintendent, American Motors Co., Indianapolis, Ind.; now superintendent Premier Motor Mfg. Co., Indianapolis, Ind.

Woodall, Herbert J., formerly chief engineer, Mercury Cyclecar Co., Detroit, Mich.; now sales manager Mercyco Sales Co., Chicago, Ill.

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POSITIONS AVAILABLE

The following announcements are published for the information of members of the Society. No charge whatever is made for these announcements. Members who wish additional information will please address the office of the Society:

55. Tool draftsmen. Men experienced on motor design.

123. Production manager or production superintendent. Man who can reduce costs and get out quantities.

127. Salesman for heavy trucks on a commission basis. Not necessary to give entire time.

*135. Sales manager, salary and commission to be agreed upon.

142. Young man familiar with machine design. Experience on presses and shears preferred. Salary dependent on experience.

*147 Sales manager, experienced, on commercial work, and in a position to invest $2,000. Exceptional opportunity.

*151. Salesman to handle special steels in New England. Must be technically trained and have had practical experience in machining and heat treating of steels.

*158. Draftsmen, with experience in designing small motors or generators for automobiles. For factory manufacturing small interchangeable parts for electrical apparatus. Only those having had at least three to four years' experience need apply. Salary $18 to $22.

159. Designer of successful special machine tools for multiple coincident operations, to design various machines for rapid production of small vehicle parts. Should have factory production experience.

*161. Manager for service, parts division and garage of large corporation. Must have excellent engineering and executive ability, besides broad experience in this particular line of work.

*167. Salesman, one that is capable of managing sales department, familiar with the automobile trade and of pleasing personality.

168. Salesmen for electrically-driven tire-pumps for private garage use, on a commission basis.

169. A high-grade retail salesman of moderate-priced pleasure cars for New York City proper.

172. Tool draftsman. State experience and salary desired.

173. Assistant engineer; must have some shop and at least two years' motor testing and operating experience. Moderate salary, which will be increased as circumstances and conditions might warrant.

*Send written application to S. A. E. office to be forwarded to employer.

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174. Engineer or experienced man capable of designing attachment parts for shock absorber.

*175. Office manager for office of thirty clerks of an established Massachusetts manufacturing corporation, employing 200 men. Experience needed in accounting, credits, correspondence, purchasing, sales, systems, etc.

176. Inspector on automobile parts. Must be A1 man.

*177. Salesman for modern brass foundry specializing on automobile castings. Salary including bonus about $3600 per year. Good territory for right man, who could run the compensation up to $5000 in two or three years' time.

178. Draftsman.

*179. Expert final chassis tester and motor expert, on commercial work.

180. Chemist.

181. Technical graduate of two or three years' experience, preferably in production end of automobile manufacture, for office work in sales and order department of parts manufacturer; leading to sales engineer.

182. Draftsman. Position will pay $60 to $75 per month.

183. Draftsman. Position will pay $90 to $100 per month.

184. Draftsman.

*185. Wanted by one of the largest automobile accessory manufacturers, a first-class man on die castings (especially die-cast aluminum) to organize a separate department. This is an opportunity for a man who is no has-been or experimenter. Give full particulars in first letter or no notice taken.

186. Assistant mechanical engineer for automobile factory in the middle West. Prefer technical school graduate but must have had a number of years' practical experience, preferably with the larger automobile manufacturers.

*187. Experienced superintendent of repair department of large garage. Young man with technical education preferred. Excellent opening for capable man. Applications from men without considerable experience in automobile repair work not considered. State minimum salary expected and qualifying experience.

188. Assistant in purchasing department.

189. Foundry foreman; one who can handle men and knows foundry business, especially in the cast-iron line.

190. Experienced production man for a light four-cylinder car.

191. Mechanical designers with experience on ignition, electric starters, etc. State age, education, experience in detail, whether married and salary expected.

*Send written application to S. A. E. office to be forwarded to employer.

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0234. Mechanical engineer, twelve years' experience with some of the best automobile companies of the country wishes position as sales engineer in progressive concern making some kind of mechanical specialty.

0255. Service engineer, carburetion especially. Twelve years' experience in motor car troubles. Would like position as assistant manager of service department, taking the practical detail work.

0256. Well and favorably known in automobile trade. Last five years sales manager prominent parts manufacturer. American speaking French, German and some Spanish. Prefer connection with good automobile company as export manager and foreign representative or salesmanager of first-class accessory or parts manufacturer.

0257. Draftsman and designer, experienced in design of motor trucks, adding machines, with broad technical education supplemented with shop work, desires a position as designer and engineer in charge of drafting room or engineering department. Have practical experience, able to work out mechanical design. Eight years' experience in automobile and adding machines. Can handle men.

0258. Engineer, capable, energetic, ten years' experience on pleasure, commercial car and electric starter work, desires position as mechanical engineer or chief draftsman. Would like to connect with small live company in which later a financial interest might be taken. Have specialized on efficient running of drafting room, and would consider temporary engagement for systematizing work.

0259. Motor and chassis designer and checker. Technical graduate with shop experience; specialist on design for quantity production. Have had several months' shop experience with firm building stationary engines, jobbing shop, and with a general manufacturer.

0260. Engineer and producer; ten years' automobile experience as designer, chief engineer and factory manager. Mechanical engineer graduate, thirty-two years old, able and reliable; last position, engineer and factory manager of large plant; connections severed when plant was changed from automobile manufacturing to making of one unit only. Best reference.

0261. Engineer with thirteen years' experience in design and construction of automobiles, trucks; automobile, stationary and marine two-cycle and four-cycle engines for both gasoline and kerosene. Ten years with present employers in large factory. Open for position soon. Manager or engineer in suitable situation desired. Age, 39 years.

0262. Mechanical engineer, eight years' experience in engineering work on light trucks and small cars. Exceptionally good practical experience. Good correspondent and familiar with costs. Capable

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of handling responsible position. Prefer connection with concern manufacturing product or with parts manufacturer. Have an interesting cyclecar design for any one favoring the new field. Have held present position as chief engineer for past three years.

0263. Designing engineer with broad experience on designing and manufacture of pleasure cars with well-known concerns. Employed at present. Best references.

0264. Factory manager, good organizer and producer with wide experience in engineering and production of both pleasure and commercial cars.

0265. Engineer with eleven years' experience in design and construction of high-class American cars. Specialist in development of high-speed efficiency motors. Authority on carburetion.

0266. Young man experienced as purchasing agent, desires to secure a position with a future.

0268. Mechanical and electrical engineer now employed, experienced in designing, engineering, superintending constructions and productions in quantity, sheet metal specialties and electric vehicles; also gasoline cars. Open for position in New York City or immediate vicinity.

0269. Body or executive engineer for chassis department in or near Detroit. Have been "producing" for ten years and am at present with one of the largest and best known manufacturers of automobiles in the world.

0270. Engineer and factory manager, of wide mechanical experience; last nine months on light cars; thorough mechanic.

0271. Position desired as superintendent or chief inspector. Have had charge of men for fifteen years. Experience covers several years' designing gasoline motors, on transmission and gears, in charge of inspection with well-known automobile company building a high-grade car. At present employed as chief inspector with one of the largest automobile companies making sheet metal stampings using small and large dies.

0272. Engineer and purchasing agent, with eight years' experience in light pleasure car and all capacities of commercial car designing, is open for engagement. Can furnish first-class references.

0273. Young man of 25, with four years' experience on the editorial staffs of automobile trade papers is at the disposal of an advertising manager. Would be glad to submit advertisements that he wrote while doing editorial work. Not a "know-it-all" and is willing to start for a fair living salary.

0274. Graduate mechanical engineer with fifteen years' experience in engineering and production departments of motor vehicles and accessory manufacturers, available for position soon; now engaged.

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OFFICERS OF THE SOCIETY

President, Henry M. Leland, Detroit, Michigan.

Vice-president, William Guy Wall, Indianapolis, Indiana.

Vice-president, K. W. Zimmerschied, Detroit, Michigan.

Treasurer, Hermann F. Cuntz, New York.

Chairman of Finance Committee, H. M. Swetland, New York.

Secretary and General Manager, Coker F. Clarkson, New York.

MEMBERS OF THE COUNCIL

Henry M. Leland, Detroit, Mich.

William Guy Wall, Indianapolis, Ind.

K. W. Zimmerschied, Detroit, Mich.

Hermann F. Cuntz, New York.

Joseph A. Anglada, New York.

Harold L. Pope, Hartford, Conn.

E. F. Russell, Longmeadow, Mass.

Christian Girl, Cleveland, Ohio.

Henry C. Wilson, New York.

Walter C. Baker, Cleveland, Ohio.

H. W. Alden, Detroit, Mich. (Past President).

Howard Marmon, Indianapolis, Ind. (Past President).

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SECTIONS OF THE SOCIETY

DETROIT SECTION

E. T. BIRDSALL.....*Chairman*
C. T. MYERS and W. N. OSBURN.....*Vice-Chairmen*
HERBERT L. CONNELL.....*Secretary and Treasurer*
FERDINAND JEHLE.....*Asst. Secretary and Treasurer*

(Address) 109 Webb Avenue, Detroit, Mich.

Meets first Thursday each month at 8 p. m., in the Employers' Association Rooms, Stevens Building, Detroit, Mich.

INDIANA SECTION

R. H. COMBS.....*Chairman*
GEORGE A. WEIDELY.....*Vice-Chairman*
JOHN G. WOOD.....*Treasurer*
CHAS. P. GRIMES.....*Secretary*

(Address) Wheeler & Schebler, Indianapolis, Ind.

Meets first Tuesday after first Wednesday each month at 8 p. m., at the Hoosier Motor Club in the Claypool Hotel, Indianapolis, Ind.

METROPOLITAN SECTION

JOSEPH A. ANGLADA.....*Chairman*
HERBERT CHASE.....*Treasurer*
N. B. POPE.....*Secretary*

(Address) 1790 Broadway, New York City.

Meets last Thursday each month, except July and August, 8 p. m., at the Automobile Club of America, 247 West Fifty-fourth Street, New York City.

CLEVELAND SECTION

JAMES H. HERRON.....*Chairman*
H. B. ANDERSON.....*Vice-Chairman*
A. J. SCAIFE.....*Treasurer*
R. J. NIGHTINGALE.....*Secretary*
E. R. HALL, J. H. HERTNER, R. H. MANSON.....*Members Board of Directors*

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FILL OUT AND SEND TO S. A. E. OFFICE

GENERAL COMMITTE ON ARRANGEMENTS,

SOCIETY OF AUTOMOBILE ENGINEERS,

1790 BROADWAY, NEW YORK CITY.

I { do / do not } .....intend to take part in the S. A. E. Second European Visit, October-November, 1914.

I expect to decide definitely as to taking the trip by.....

.....
DATE

I will be accompanied on the trip by.....

.....
(Members and their immediate family only are entitled to join the party)

.....
S. A. E. MEMBER.

.....
ADDRESS

Date.....

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Members are requested to advise the S. A. E. office promptly of change of address, using form herewith:

SECRETARY,

SOCIETY OF AUTOMOBILE ENGINEERS,

1790 Broadway, New York City.

Please change my address now appearing on your records, to the following:

Company connected with.....

Profession or Position.....

Address of Company.....

Address for Mail.....

Articles Manufactured.....

.....

.....

.....

.....

.....

.....

.....

Very truly yours,

.....

S. A. E. Member.

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FILL OUT AND SEND TO S. A. E. OFFICE

SECRETARY,

SOCIETY OF AUTOMOBILE ENGINEERS,

1790 BROADWAY, NEW YORK CITY.

Please send application blank to

.....

NAME

.....

POSITION AND COMPANY

.....

ADDRESS

whom I consider eligible to S. A. E. membership.

.....

S. A. E. MEMBER

.....

ADDRESS

Date.....

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FILL OUT AND SEND TO S. A. E. OFFICE

SECRETARY,

SOCIETY OF AUTOMOBILE ENGINEERS,

1790 BROADWAY, NEW YORK CITY.

Please send application blank to

.....

NAME

.....

POSITION AND COMPANY

.....

ADDRESS

whom I consider eligible to S.A.E membership.

.....

S. A. E. MEMBER

.....

ADDRESS

Date.....

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S. A. E. BULLETIN

Vol. VI August, 1914 No. 5

REVISED CONSTITUTION

ELECTRIC TRANSMISSIONS

PNEUMATIC GEAR-SHIFTING

SELECTING BALL AND ROLLER BEARING SIZES

WOOD WHEELS FOR HEAVY VEHICLES

TENDENCY IN BODY DESIGN

Issued to Members
by the

SOCIETY OF
AUTOMOBILE ENGINEERS

1790 Broadway, New York

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S. A. E. Bulletin

VOL. VI AUGUST, 1914 No. 5

Published by the Society of Automobile Engineers
1790 Broadway, New York
HENRY M. LELAND, President. COKER F. CLARKSON, Secretary.
HERMANN F. CUNTZ, Treasurer.

Issued monthly, 50 cents a number, $5.00 a year. Entered as second-class matter, April 9, 1912, at the post office at New York, New York, under the Act of July 16, 1894.

REVISED CONSTITUTION

The amendments to the Constitution presented, discussed and amended at the meetings of the Society held in January and June were almost unanimously carried in the written ballot of the members, the closure of voting on which was had this month. The report of the tellers appointed by President Leland is appended to the Constitution as printed complete herein as revised.

IMPORTANT CHANGES

The object of the Society as set forth in paragraph 2 of the Constitution is broadened specifically to include promoting Standards and Engineering Practices connected with the design and construction of automobiles, all forms of self-propelled or mechanically-propelled mediums for the transportation of passengers or freight, and internal combustion prime-movers. This, as is known, is declaratory of the procedure of the Society work in recent years. Under the old Constitution the standards and recommended practice work was described in a general way only, the appointment of professional committees by the Council and the

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acceptance of reports recommended by such committees by the Society being authorized.

Under the new Constitution reports of Standards or Professional Committees or sub-committees or divisions thereof may be approved or adopted as the action of the Society. The Society may approve or adopt any standard, formula or engineering practice, but cannot approve any engineering or commercial enterprise. It cannot consent to the use of its name or initials in any commercial work or business except to indicate conformity with its standards or recommended practices. The right to use the Society emblem may not be granted to any but members, and then for Society purposes only.

A department, bureau or office of a national, state, county or municipal government interested in the object of the Society may now become a Departmental Member thereof.

The qualifications for Junior grade of membership have been changed, persons under twenty-six years of age and qualified to fill subordinate engineering positions in the automobile or allied industries, or regularly enrolled students or graduates of a technical school, now being eligible thereto. Formerly the qualifications for Junior grade of membership were identical with those of Member grade, except as to age. One effect of this was that upon reaching the age of twenty-six Junior members went practically automatically into Member grade. Under the present Constitution a Junior member will not necessarily be transferred to a different grade until reaching the age of thirty.

As has been the practice for a long time in some engineering societies and like the method of societies similar to the S. A. E., the election of all applicants for membership is now by the Council instead of by the voting members of the Society.

The initiation fee and annual dues of Associates have been increased to be the same as for Membership.

Under the old Constitution the following committees were designated standing committees: Finance Committee, Meetings Committee, Publication Committee, Membership Committee. The term of one member of each of these committees expired at the end of each annual meeting. Under the present Constitution all of the members of these committees are to be appointed annually by the President.

The method of naming of the regular Nominating Committee of the Society has been changed entirely. Formerly the members thereof were appointed by the President. Hereafter four members of the Nominating Committee, the number of which has been increased from five to seven, will be elected annually at each Semi-annual Meeting of the Society preceding the Annual Meeting at which officers are to be elected, the three Sections of the Society having the largest membership having theretofore each elected one member of the Committee.

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Persons under thirty years of age who are students of recognized institutions of learning or pursuing courses in automobile engineering, may enroll as students for a term of three years and receive some of the benefits of the Society, but will not in any sense become members thereof.

The new constitutional provisions require a change in several paragraphs of the By-Laws of the Society, the Council now having under advisement a set of amended By-Laws which will be officially voted upon at one of its early meetings and be put into effect.

It is believed that members of the Society are to be congratulated on having now a Constitution which is an orderly document consonant with the best activities of the Society.

CONSTITUTION

NAME, OBJECT AND GOVERNMENT

C 1 The title of this Society is "THE SOCIETY OF AUTOMOBILE ENGINEERS."

C 2 The object of the Society is to promote the Arts and Sciences and Standards and Engineering Practices connected with the design and construction of automobiles, all forms of self-propelled or mechanically propelled mediums for the transportation of passengers or freight, and internal combustion prime movers. The principal means for this purpose shall be the holding of meetings for the reading and discussion of professional papers and reports, the publication and distribution of the same, and social intercourse.

C 3 The Society shall be governed by this Constitution and by By-Laws and Rules in harmony therewith.

C 4 The Society shall be organized as a Corporation under the laws of the State of New York. Its offices shall be located in the City of New York.

MEMBERSHIP

C 5 The membership of the Society shall consist of Honorary Members, Members, Associates, Juniors, Departmental Members and Affiliate Members. Honorary Members and Members are entitled to vote and to hold office. Associ-

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ates, Juniors, Departmental Members and Affiliate Members shall not be entitled to vote or to be officers of the Society, but shall be entitled to the other privileges.

C 6 Honorary Members and Members are entitled to vote on all questions at any meeting of the Society, in person, or by proxy given to a voting member. A proxy shall not be valid for a greater time than six months.

C 7 Honorary Members shall be persons of acknowledged professional eminence, and their number shall not exceed one per cent. of the total membership at the time of their election.

C 8 Member grade shall be composed of persons twenty-six years of age or over who, by previous technical training or experience or by present occupation, are qualified to act as designers or constructors of complete automobile vehicles, or their component parts, or their equipment, or to exercise technical supervision of the production of materials of engineering construction; or to take responsible charge of automobile engineering work; or to impart technical instruction in automobile vehicle construction and operation.

C 9 Associate grade shall be composed of persons who are engaged in the automobile and related industries in a responsible commercial or financial or manufacturing capacity, or who are so connected with the automobile and related industries as to be competent to co-operate with automobile engineers.

C 10 Junior grade shall be composed of persons who at the time of election are under twenty-six years of age and qualified to fill subordinate engineering positions in the automobile or allied industries, or who are regularly enrolled students at or graduates of a technical school. A Junior member may upon reaching the age of twenty-six and shall upon reaching the age of thirty be transferred to Member or Associate grade, in accordance with the decision of the Council as to which grade his qualifications entitle him.

C 11 An Affiliate Member shall be a firm or corporation interested in the object of the Society as set forth in C 2. Affiliate Members shall designate and maintain at least one

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personal representative, and, with the approval of the Council, may designate five additional personal representatives.

C 12 A Departmental Member shall be a department, bureau or office of a national, state, county or municipal government interested in the object of the Society as set forth in C 2. The life of a Departmental membership shall comprise a first period of ten years, with extensions of like periods, or otherwise, in the discretion of the Council. Departmental Members shall, upon notification of election, designate and maintain one personal representative.

C 13 The rights and privileges of every Honorary Member, Member, Associate and Junior shall be personal to himself, and shall not be transferable by his own act or by operation of law. Departmental Membership and Affiliate Membership also shall not be transferable.

ADMISSION

C 14 Honorary Members shall be nominated by at least ten Members of the Society. The grounds upon which the nomination is made shall be presented to the Council in writing.

C 15 All original applications for election to the grade of Member, Associate or Junior shall be presented to the Council, which shall consider and act upon each application, electing each applicant to the grade of membership to which, in its judgment, his qualifications entitle him. Two negative votes shall defeat an election.

C 16 Upon written request by the applicant, the Council may transfer a member from one grade to another, providing satisfactory proof is presented to it that said member is qualified for transfer to the other grade.

C 17 The election of Honorary Members shall be by a vote of the Council taken by letter ballot, as provided in the By-Laws. One dissenting vote shall defeat such election.

C18 The election of Departmental Members and Affiliate Members shall be by a majority vote of the Council.

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C 19 Each member elected, excepting Honorary Members, shall pay initiation fee and current dues before becoming entitled to the rights and privileges of membership. Upon noncompliance with this requirement within three months after notice of election, the election becomes void.

INITIATION FEES AND ANNUAL DUES

C 20 The initiation fee for membership in each grade and for student enrollment shall be as follows:

For Member	$25.00
For Associate	25.00
For Junior	10.00
For Student Enrollment	None
For Departmental Member	100.00
For Affiliate Member	50.00

C 21 The annual dues for membership in each grade and for student enrollment shall be as follows:

For Member	$15.00
For Associate	15.00
For Junior	5.00
For Student Enrollment	3.00
For Departmental Member	None
For one Affiliate Member Representative	$15.00
For each additional Affiliate Member Representative	10.00

C 22 Upon transfer of a Junior to Member, or Junior to Associate, such member shall pay the difference in initiation fee of the grades; and thereafter pay the annual dues for the grade to which he is transferred.

LIFE MEMBERS

C 23 The Council may, in its discretion, permit any Member or Associate to become a Life Member in the same grade, by the payment at one time of an amount sufficient to purchase from the Equitable Life Assurance Society, of New York, an annuity on the life of a person of the age of the applicant, equal to the annual dues in this grade. Such Life Member shall not be liable thereafter for annual dues.

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C 24 The Council shall have the power, by letter ballot, to admit to Life Membership, without the payment of a life membership fee, any person who, for a long terms of years, has been a Member or an Associate, when, for special reasons, such procedure would, in its judgment, promote the best interests of the Society, provided that notice of such proposed action shall have been given at a previous meeting of the Council. One dissenting vote shall defeat such admission.

SUSPENSIONS AND EXPULSIONS

C 25 Any Member, Associate, Junior or Affiliate Member who shall leave the annual dues unpaid for three months shall not receive any publications of the Society until such arrears are paid. Any Member, Associate, Junior or Affiliate Member who shall leave the dues unpaid for one year shall, in the discretion of the Council, cease to have any further rights in the Society and be stricken from the roll of membership. The resignation of a member, whose account with the Society is not fully settled, can be accepted only by vote of the Council.

C 26 The Council may temporarily suspend the annual payment of dues by any Member, Associate or Junior, whose circumstances have become such as to make it impossible for him to pay the dues, and may under similar circumstances, remit the whole or a part of dues in arrears. Such action shall be taken only upon the written application of the Member, Associate or Junior, signed by three other members in good standing.

C 27 Any member of any grade who in the judgment of the Council has violated the Constitution, By-Laws or Rules of the Society, or, in the opinion of the Council by a unanimous vote, has been guilty of conduct rendering such member unfit to continue in the membership of the Society, may be expelled from membership, provided, that in all such cases, the member shall have been given written notice of the charges and an opportunity to defend himself.

DUES NOT RETURNABLE

C 28 Members of any grade shall not be entitled to any return of fees or dues upon severing their connection with the Society.

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THE COUNCIL

C 29 The affairs of the Society shall be managed by a board of twelve directors chosen from among its Members or Honorary Members, which shall be styled "The Council." The Council shall consist of the President, the First Vice-president, the Second Vice-president, six Councilors, the Treasurer and the two surviving Past-presidents who last held office. Four Members of the Council shall constitute a quorum for the transaction of business. The Secretary may take part in the deliberations of the Council, but shall not have a vote therein. The Chairman of the Finance Committee and the Chairman of the Standards Committee may attend the meetings of the Council and take part in the discussion of questions affecting their committees, but shall not have a vote.

C 30 Should a vacancy occur in the Council, or in any elective office except the Presidency, through death, resignation or other cause, the Council may elect a Member or Honorary Member to fill the vacancy until the next annual election.

EXECUTIVE COMMITTEE

C 31 The Council shall regulate its own proceedings and may by resolution delegate specific powers to an Executive Committee or to any one or more members of the Council. No act of the Executive Committee or of a delegate shall be binding until it has been approved by a resolution of the Council.

ANNUAL REPORT

C 32 The Council shall present at the annual meeting of the Society a report, verified by the President or Treasurer or by a majority of the Members of the Council, showing the whole amount of real and personal property owned by the Society, where located, and where and how invested, and the amount and nature of the property acquired during the year immediately preceding the date of the report, and the manner of the acquisition; the amount applied, appropriated or expended during the year immediately preceding such date, and the purposes, objects or persons to or for which such applications, appropriations, or expenditures have been made; also the names and places of residence of the persons who have been admitted into membership

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in the Society during the last year; which report shall be filed with the records of the Society, and an abstract thereof shall be entered in the minutes of the proceedings of the Annual Meeting.

IMPLIED SANCTION

C 33 An act of the Council which shall have received the expressed or implied sanction of the membership at any subsequent meeting of the Society, shall be deemed to be the act of the Society, and shall not afterwards be impeached by any member.

VACATING OFFICES

C 34 The Council may, by a two-thirds vote of the members present, declare any elective office vacant, on the failure of its incumbent for six months, from inability or otherwise, to attend the Council meetings, or to perform the duties of his office, and shall thereupon appoint a Member or Honorary Member to fill the vacancy until the next Annual Meeting. The said appointment shall not render the appointee ineligible to election to any office.

OFFICERS

C 35 At each Annual Meeting there shall be elected from among the Members and Honorary Members:

A President, to hold office for one year
A First Vice-president, to hold office for one year
A Second Vice-president, to hold office for one year
Three Councilors, each to hold office for two years
A Treasurer, to hold office for one year

C 36 The election of officers shall be by sealed letter ballot, as the By-Laws shall provide.

C 37 The term of all elective officers shall begin on the adjournment of the Annual Meeting of the Society. Officers shall continue in their respective offices until their successors shall have been elected and accepted their offices.

C 38 A President, a Vice-President or any other voting member of the Council, except the Treasurer, shall not be eligible for immediate re-election to the same office at the expiration of the term for which he was elected.

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SECRETARY

C 39 The Council at its first meeting after the Annual Meeting of the Society, shall appoint a person of the grade of Member to serve as Secretary of the Society for one year, subject to removal for cause by an affirmative vote of the members of the Council, at any time after one month's written notice has been given him to show cause why he should not be removed, and he has been heard in his own defense, if he so desires. The Secretary shall receive a salary which shall be fixed by the Council at the time of his appointment.

DUTIES OF PRESIDENT, SECRETARY AND TREASURER

C 40 The President, Secretary and Treasurer shall perform the duties legally or customarily attaching to their respective offices under the laws of the State of New York, and such other duties as may be required of them by the Council.

MEETINGS

C 41 The Society shall hold two meetings in each year. The Annual Meeting and a Semi-Annual Meeting shall be held at such time and place as the Council may appoint. Fifty voting Members shall constitute a quorum for the transaction of business.

C 42 Special meetings of the Society may be called at any time at the discretion of the Council, or shall be called by the President upon the written request of ten per cent. of the voting membership, the notices for such meeting to state the business for which they are called; and no other business shall be entertained or transacted at any such special meeting.

APPROPRIATIONS

C 43 Any appropriation recommended by the Society at a meeting, shall not take effect until it shall have been approved by the Council.

VOTE REQUIRED FOR ACTION

C 44 Every question which shall come before a meeting of the Society or of the Council or of a committee, shall be decided by a majority of the votes cast, unless otherwise provided in this

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Constitution or By-Laws, or the Laws of the State of New York. The Council may order the submission of any question to the membership by letter ballot. Any meeting of the Society at which a quorum is present, may order the submission of any question to the membership by letter ballot.

ADMINISTRATIVE COMMITTEES

C 45 The President shall within thirty days after taking office appoint, from the individual membership of the Society, the following Committees, designating the Chairmen thereof:

Finance Committee, consisting of five members
Meetings Committee, consisting of five members
Publication Committee, consisting of five members
Membership Committee, consisting of five members
House Committee, consisting of five members
Tellers as required by the By-Laws

NOMINATING COMMITTEE

C 46 The Nominating Committee shall consist of seven Members, and be elected annually. Four members of the committee shall be elected at the business session of the Semi-Annual meeting of the Society preceding the Annual meeting at which officers are to be elected. The three Sections of the Society having the largest membership shall each elect one member of the committee, prior to the respective Semi-Annual meeting of the Society.

C 47 *Special Nominating Committee*

Twenty or more members entitled to vote may constitute themselves a Special Nominating Committee, with the same power as the Annual Nominating Committee.

STANDARDS AND PROFESSIONAL COMMITTEES

C 48 The Council shall appoint annually such Standards or Professional Committees, or sub-committees or Divisions thereof as it may deem desirable, to investigate, consider and report upon subjects of interest to the Society. The Chairmen of such committees, and of their subdivisions, shall be designated by the President. Reports of such committees may be accepted by the Society and printed in its publications, and may be approved or adopted as the action of the Society.

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DUTIES OF COMMITTEES

C 49 All committees of the Society shall perform the duties required of them by the By-laws, or assigned to them by the Council. The President and the Secretary of the Society shall, ex officio, be members of all the committees and subdivisions thereof. Any proposed expenses of such committees must be authorized by the Council before they are incurred.

REMOVAL OF COMMITTEE MEMBERS

C 50 The Council may at any time, in its discretion, remove any or all members of any committee, except of a Nominating Committee; and the vacancy, arising from this or from any other cause, shall be filled by appointment by the President.

SECTIONS OF THE SOCIETY

C 51 The Council may, in its discretion, authorize the organization of Sections of any or all grades of membership, for purposes which are in harmony with the object of the Society. Such Sections may be geographical or professional, and shall have such powers and act under such rules and regulations as the Council may from time to time prescribe. The Constitution and By-Laws of such Sections shall be in harmony with the Constitution, By-Laws and Rules of the Society and shall receive the approval of the Council before going into effect.

STUDENT ENROLLMENT

The Council may further, in its discretion, authorize the enrollment, individually or by group, of persons under thirty years of age who, at the time of application, shall be bona fide students of a recognized institution of engineering, or pursuing a course of study in automobile engineering. Student enrollment shall be for a term of three years, which term shall not be renewable. Enrolled students shall not be members of the Society, or be entitled to vote or hold office.

PUBLICATIONS

C 52 The official record of papers, reports and discussions and other literature of interest to the Society shall be published and distributed as the Council may direct. The public shall

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have free access to the library of the Society, under such regulations as the Council may formulate.

C 53. The Society shall claim no exclusive copyright to any papers read at its meetings, or any reports or discussions thereon. The policy of the Society shall be to give the papers read before and reports adopted at its meetings wide circulation, with a view to making the work of the Society known, encouraging engineering progress, fulfilling the Society's object and extending the professional reputation of its members.

C 54 The Society shall not be responsible for statements or opinions advanced in papers or in discussions at its meetings. Matters relating to politics or purely to trade shall not be discussed at a meeting of the Society, or be included in its publications.

STANDARDS AND FORMULAS

C 55 The Society may approve or adopt any standard, formula or engineering practice, but shall not approve any engineering or commercial enterprise. It shall not consent to the use of its name or initials in any commercial work or business, except to indicate conformity with its standards or recommended practices.

The right to use the Society emblem shall not be granted to any but members and then only for Society purposes.

AMENDMENTS TO THE CONSTITUTION

C 56 At any Annual or Semi-Annual Meeting of the Society any voting member may propose in writing an amendment to this Constitution. Such proposed amendment shall not be voted on at that meeting, but, if duly seconded by a voting member, shall be open to discussion and to such modification as may be accepted. The proposed amendment shall be mailed by the Secretary to each member of the Society entitled to vote, at least sixty days previous to the next Annual or Semi-annual Meeting, accompanied by comment of the Council, if it so elects. At that Annual or Semi-Annual Meeting such proposed amendment shall be presented for discussion and final amendment, and shall subsequently be submitted by letter ballot to all members entitled to vote, provided that 20 votes are cast in favor of such submission. The letter ballot, accompanied by the text of the proposed amendment, shall be mailed by the Secretary to each member of the Society entitled to vote, promptly after the close of the said meeting. Thirty days after the date on which the ballots

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are mailed to the voting membership, the ballots returned shall be counted by Tellers appointed as provided in the By-Laws. The Tellers shall announce immediately the result of the vote, which shall be mailed to the members by the Secretary. The adoption of the amendment shall be decided by a majority of the votes cast.

An amendment shall take effect immediately upon the announcement of its adoption.

AMENDMENTS TO BY-LAWS AND RULES

C 57 For the further ordering of the affairs of the Society, the Council may, by a two-thirds vote of its members present, amend the By-Laws in harmony with this Constitution, provided that written notice of such proposed amendment shall have been given at the previous regular meeting of the Council; and, provided further, that the Secretary shall have mailed to each member of the Council a copy of such proposed amendment, at least ten days in advance of the meeting of the Council at which action is to be taken. The amendment shall take effect immediately on its passage by the Council. Such amendment shall be announced in the next regular publication of the Society.

C 58 The Council may, by a majority vote of the members present at any meeting, establish, amend, or annul Rules for the conduct of the business affairs of the Society; for the ordering and conduct of its professional or business meetings; and for the guidance of its committees in their work and reports—provided that such Rules are in harmony with the Constitution and By-Laws of the Society.

REPORT OF TELLERS ON CONSTITUTIONAL AMENDMENT BALLOT

August 15th, 1914.

Society of Automobile Engineers,
1790 Broadway, New York City.

Gentlemen:

The result of votes cast by S. A. E. members, counted to-day, is as follows:

AFFIRMATIVE	NEGATIVE	VOID	TOTAL
225	3	2	230

We hereby authorize the Secretary to announce the above to the members of the Society.

(Signed) JOSEPH A. ANGLADA,
NIRAN BATES POPE,
HERBERT CHASE,
Tellers.

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THE S. A. E. HANDBOOK

The S. A. E. Handbook, inaugurated during the presidency of Henry Souther largely as a result of his idea and work, has been a distinct success and is growing rapidly. In it are contained versions of the S. A. E. standards and recommended practices and general engineering matter approved by the Data Sheet Division as pertinent in a more or less important way to automobile engineering practice. The last mentioned matter is, of course, largest in volume, and under the very able leadership of B. D. Gray, chairman of the Data Sheet Division, is being issued as rapidly as conditions permit.

Last January eighty-eight data sheets were issued. These referred to both S. A. E. recommended practices and general engineering data. Later ten data sheets of Society recommended practices were issued. One hundred and thirty-three sheets relating principally to general automobile engineering data were distributed among the members this month.

As stated in a recent communication from Mr. F. G. Hughes, the data in the S. A. E. book have proven so valuable from an engineering viewpoint that their place could not be occupied by any other set of data now extant. The principal function of the data is perhaps the use by draftsmen which obviates the creation and production of designs containing immaterial differences from the S. A. E. practices. In the recommendations made by the professional committees of the Society it has always been borne in mind that the development of parts susceptible to improvement in design should not be interfered with. It has been very clear, however, that there are almost innumerable details relating to automobile designe and construction which are capable of standardization.

All members of the Society receive at the time of election complete sets of S. A. E. Data Sheets and supplemental sheets issued thereafter. The data sheets are also sold to non-members of the Society at proper prices. The original action of the Society in issuing data sheets in loose-leaf form has proven very happy, as it permits rapid supersedence of a given sheet in case of any error found therein or new development in the art requiring cognizance. The data sheets are issued in two sizes, both of which fit standard forms of loose-leaf folders, the smaller size measuring 4¼ x 7¼ and the larger sheet 8½ x 11. The Council of the Society has recently authorized the issuance of the larger data sheet in order that matter which cannot be incorporated properly on the smaller data sheets can be shown.

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EUROPEAN TRIP POSTPONED

As will doubtless have been anticipated by the members, the Second European Visit of the Society scheduled for this autumn will not be made, owing to the deplorable state of war prevalent among our British and Continental brethren. The decision was formally reached at the meeting of the Council held this month that the trip be postponed indefinitely.

THE SECTIONS

The work of the Sections of the Society has been maintained with steady and increasing interest. In addition to the Detroit, Indiana and Metropolitan Sections, a Section has been formed in Cleveland, and one will probably be started in Chicago. Through the general very generous spirit of co-operation among the members methods whereby the work of the Sections can be conducted as efficiently as possible are being devised. This will certainly enhance the value of the technical product of the Society, as well as continue and extend the already existing admirable fellowship among S. A. E. members.

STANDARDS COMMITTEE APPOINTMENTS

The Council has recently added several members to the personnel of the Standards Committee, the appointments being as specified below with the respective assignments:

Carbureter Fitting Division—C. P. Grimes.

Commercial Car Wheels Division—F. F. Phillips.

Data Sheet Division—E. S. Foljambe.

Electrical Equipment Division—H. W. Harper, Joseph Bijur, H. G. Osburn.

Lock Washers Division—C. W. McKinley.

Miscellaneous Division—E. R. Whitney

Research Division—Daniel Roesch.

Springs Division—C. E. Clemens, C. E. Reddig, C. W. McKinley.

Standards Exchange Division—W. F. Herst, W. R. Strickland.

BROACHES DIVISION ACCOMPLISHMENT

In the considerable volume of work accomplished by the Standards Committee there is perhaps none more conspicuous or clean-cut than that of the Broaches Division (of which C. W. Spicer is chairman), which has made recommendations for square broached fittings, taper fittings, six-spline fittings, ten-spline fittings and four-spline fittings, which have been accepted by the Society.

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COMPARABLE MOTOR TEST DATA

The Motor Testing Division has, after some years of study, contributed specific recommendations of great value for use in the conduct of commercial tests of internal combustion motors. This information has been reduced to three forms upon which the characteristics of the motors, as well as of the accessories thereof, and the test results will be indicated, and a code specifying useful points for consideration in the conduct of the tests. It is confidently expected that the work of the Motor Testing Division will result in much good in that it will permit really approximate comparison of test results of motors of various makes, inasmuch as the above mentioned forms will be used in making the tests in the factories throughout the country. The prospective use of such forms by the members of the Society generally was one of the prime considerations actuating the Council in authorizing a larger size of data sheets. The work of the Motor Testing Division has proceeded along the idea expressed some years ago by Mr. H. L. Connell, secretary of the Detroit Section of the Society. Mr. John O. Heinze is the chairman of the Division, and has devoted a great deal of time to its work. Mr. Herbert Chase has also given considerable time to the consideration of the details of the recommendation of the Division.

PLEASURE CAR WHEELS DIVISION

The interest at the session of the Society this summer in the strength tests of rims for pneumatic tires made for the Pleasure Car Wheels Division was commensurate with that of almost any of the subjects presented, owing to the fact that the data were absolutely new, having been secured only after an expenditure of considerable time and money by two tire manufacturing companies. Allied with the work of the S. A. E. committees is the consideration of the standards of pneumatic rims recently promulgated by the Society of Motor Manufacturers and Traders of Great Britain and now generally adopted as the European standard. There was presented at the summer meeting a very keen and clear analysis of points involved in these European standards with reference particularly to the tolerances from precise measurement specified which vary greatly from figures specified in American practice.

ELECTRICAL EQUIPMENT DIVISION

The Electrical Equipment Division, of which Past-President Riker is chairman, is doing splendid work in clarifying the more or less new points involved in the installation of electrical

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apparatus on gasoline cars. It is very generally felt that standardization of these elements of motor car construction at this time so far as possible will be of very great value to the parts makers, car manufacturers, service departments and car owners.

MISCELLANEOUS DIVISION WORK

The Miscellaneous Division (John G. Utz, chairman) is dealing with a number of questions, all important, including recommendations conforming to and anticipating advance practice as to spark plug shells, details of rod and yoke ends, etc. The Division is also studying some large subjects, such as uniformity of license pads used in various states, not to speak of gasoline and lubricating oil specifications.

STOCK SIZES OF ROLLER BEARINGS

The Ball and Roller Bearing Division is proceeding upon the theory that it will be possible to reduce the very large number of stock sizes of roller bearings now existing. A considerable amount of data in this connection has been collected by Past-President Marmon, the chairman of the Division.

IRON AND STEEL DIVISION

The Iron and Steel Division, the merit of the work of which has been recognized generally in this country and abroad, is making promising headway in the collection from original sources of data as to the physical properties to be reasonably expected from S. A. E. steels with given heat treatments. The data as received in sufficient volume will be collated and issued to the membership in both curve and tabular form.

It is generally agreed that some materials which are being used have been reduced in price by the makers, due to the fact that the practice promulgated by the S. A. E. has thrown a great many specifications which were nearly identical into one group. Among the benefits that have been seen is the avoidance of the necessity of producing steels to specifications which, while they match each other in efficiency, so nearly approach each other without exactly coinciding that it seemed impossible for the steel producer to come anywhere near the position of being able to carry any materials in stock. High-priced branded steel is less used. It is believed that the S. A. E. is responsible for the lower prices of steel during the last several years, especially those of alloy composition.

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The forms reproduced below in small size show the manner in which the Iron and Steel Division is collecting data of physical properties of S. A. E. Steels.

EXAMPLE OF USE OF FORM.

NORMAL CHARACTERISTICS OF HEAT TREATED S.A.E. STEEL No. 2345

C	Mn	P	S	Si	Ni	Cr	V
.35	.55	.015	.025	.12	1.50	.65	—

CRITICAL POINTS

Ac1 1360 Ac2 1450 Ac3 1525°

Ar1 1200 Ar2 1274° Ar3 1200

CURVES AVERAGE OF 3 TESTS.

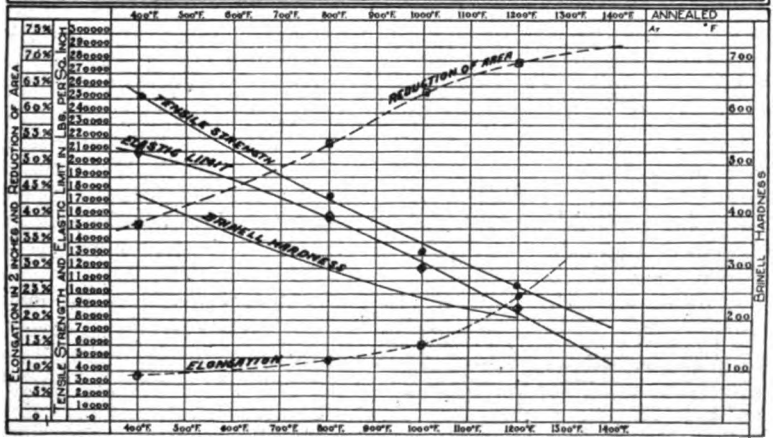
SUBMITTED BY A.B. STEEL CO.

TEST PIECE 2" X .505" DIAM.

DATE 5-1-14

HEAT TREATMENT

OPERATION	SIZE TREATED	TEMPERATURE	TIME AT HEAT	HOW COOLED	REMARKS
1 Quenched	1"	1450°	30 M	Oil	Basic O.H.
2 Annealed	1"	1250	45 M	F.C.F.	
3 Machined	To .505"				
4 Quench	.505"	1425°	30 M	Oil	
5	Drawn or annealed as indicated on curve		1 Hr.	Air	



EXAMPLE OF USE OF FORM.

NORMAL CHARACTERISTICS OF HEAT TREATED S.A.E. STEEL No. 3135

C	M	P	S	Si	Ni	Cr	V	Ac1	Ac2	Ac3	Ar1	Ar2	Ar3
.35	.55	.015	.025	.12	1.50	.56	—	1340	1460	1525	1200	1275	1560

FIGURES AVERAGE OF 3 TESTS. TEST PIECE 2" LONG-.505" DIAMETER

SUBMITTED BY A.B. STEEL CO. DATE 5-1-14

REMARKS BASIC O.H.

HEAT TREATMENT, ETC.	TENSILE STRENGTH LBS. PER SQ. INCH	ELASTIC LIMIT LBS. PER SQ. INCH	RED. AREA	ELONGATION	BRINELL HARDNESS	SHORE HARDNESS
1@ 30' @ 1550 - 45' @ 1250 : N. 505" 1@ 30' @ 1425 - 60' @ 1200	257 000	210 000	58.0	9.0	490	70
" " " " 600	210 000	185 000	46.0	10.0	360	58
" " " " 800	175 000	160 000	54.0	12.0	302	50
" " " " 1000	130 000	122 000	64.0	15.0	265	42
" " " " 1200	105 000	90 000	69.5	24.5	200	36

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Submitted at Summer Meeting

ELECTRIC VEHICLE DIVISION PROGRESS REPORT

The first meeting of the Electric Vehicle Division after its appointment was held at the headquarters of the Society on April 8, 1914. A number of members of the Standardization Committee of the Electric Vehicle Association of America were in attendance and an extended informal discussion was had as to relations between the E.V.A. Committee which has been established for a number of years and has a large volume of work under way in addition to having already adopted certain standards, and the newly appointed S.A.E. Committee. Pertinent comments were also made on the fact that the electric vehicle industry was not represented on several Divisions of the S.A.E. Standards Committee, the work of which should not be confined to standardization with reference to gasoline vehicles only, and to the fact also that several Divisions bore titles likely to cause confusion of mind since the appointment of this new Electric Vehicle Division, notably the Motor Testing Division which has to do solely with internal combustion engines, and the Electric Equipment Division which has to do solely with electric equipment on gasoline cars.

Agreement was reached to hold a second meeting before the midsummer S.A.E. Meeting after the selection of a Chairman by mail vote, at which meeting the Division should permanently organize and take up any matters which might come before it, especially the work being carried on by the E.V.A.

The second meeting was held at the Society's headquarters on June 2nd, the Electric Vehicle Association again being represented by several members, and a representative of the National Automobile Chamber of Commerce also being in attendance. The decision was reached that it was highly desirable that the S.A.E. Division should include in its membership all of the E.V.A. Committee members who are also S.A.E. members and the Council at its last meeting has considerately met our views in this matter, at the same time making some other slight changes in the committee personnel which is now constituted as follows:

Arthur J. Slade, Consulting Engineer (Chairman).
J. R. C. Armstrong, Chief Electrical Engineer, General Vehicle Co.
H. S. Baldwin, Engineer, General Electric Company.
E. J. Bartlett, Assistant Sales Manager Truck Department, Baker Motor Vehicle Co.
J. R. Coleman, Chief Engineer, Atterbury Motor Car Co.
W. H. Conant, Detroit Manager, Gould Storage Battery Co.
R. S. Fend, Chief Engineer, Woods Motor Vehicle Co.
Bruce Ford, 4th Vice-president, Electric Storage Battery Co.
John H. Hertner, Mechanical Engineer, Rauch & Lang Carriage Co.
Walter E. Holland, Research Engineer, Anderson Electric Car Co.

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Benj. Jerome, Chief Draftsman and Engineer Couple Gear Freight Wheel Co.
H. H. Kennedy, Chief Engineer, The Waverly Co.
Wm. P. Kennedy, Consulting Engineer.
Ernest Lunn, President, Walker Vehicle Co.
E. J. Ross, Jr., Mgr. Sales Engr. Dept., Edison Storage Battery Co.
T. H. Schoepf, General Engineer, Westinghouse Elec. & Mfg. Co.
W. J. B. Thomas, Chief Engineer, Century Electric Car Co.
C. A. Ward, Secy. & Treas. Ward Motor Vehicle Co.
E. R. Whitney, Chief Engineer, Commercial Truck Co. of America.
F. A. Whitten, Chief Engineer, General Motors Truck Co.
G. W. Wesley, Vice-president, General Vehicle Co.

This committee is thoroughly representative of all electric vehicle engineering interests.

In view of the sentiment of the committee that the S.A.E. should originate electric vehicle standardization work rather than the E.V.A., Mr. E. R. Whitney, Chairman of the Standards Committee of the latter, proposed to recommend to the President and the Board of Directors of that association that the records and other results of its valuable work extending over a period of years be transferred to the S.A.E. Electric Vehicle Division, and we report with pleasure that favorable action was taken on this matter at a meeting on June 19th, so that this Society can now proceed with its standardization work with the advantage of both the records and the personnel of the E.V.A. Standardization Committee.

In addition to the large volume of data on subjects under investigation by the E.V.A., standards already adopted by the National Automobile Chamber of Commerce, also data on batteries referred by the Data Sheet Division, and subjects submitted by the Division members were laid before the committee and the decision was reached to appoint five subcommittees to which all these matters could be referred. The following sub-committees were therefore created:

Motors & Controllers—W. E. Holland, Chairman, H. S. Baldwin, T. H. Schoepf.

Batteries, Wiring & Charging Appliances—G. W. Wesley, Chairman, Bruce Ford, E. J. Ross, Jr., W. H. Conant, E. R. Whitney.

Lamps—R. S. Fend, Chairman, Ernest Lunn, Benj. Jerome.

Speed and Mileage Ratings—F. A. Whitten, Chairman, E. J. Bartlett, Wm. P. Kennedy.

Tires—E. R. Whitney, Chairman, J. H. Hertner, F. A. Whitten.

To these sub-committees will be forwarded the data at present on hand from all sources and it is expected by this means prompter action can be taken on given subjects than would be possible in any other way.

In view of the fact that the following Divisions of the S.A.E. Standards Committee do not comprise in their membership any electric vehicle engineers, this Division desires that the Council give consideration to the desirability of appointing at least one electric vehicle engineer to each of the following divisions when favorable occasion offers:

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Ball and Roller Bearings.
Frame Sections.
Nomenclature.
Pleasure Car Wheels.
Springs.

Standardization on these subjects is equally of interest to the electric vehicle engineer and the gasoline vehicle engineer.

The Division is much pleased to note the appointment by the Council at its last meeting of Mr. E. R. Whitney of this Division as a member of the Miscellaneous Division.

The interest of the members of this Division is very marked and it is confidently expected that reports on both standards and recommended practice which will prove to be of value to the Society and the electric vehicle industry will be the result of its work.

Respectfully submitted.

ELECTRIC VEHICLE DIVISION,

ARTHUR J. SLADE,
Chairman.

Submitted at Summer Meeting.

RESEARCH DIVISION PROGRESS REPORT

The Research Division begs to submit the following report of progress of the investigation involving the determination of proper tap drill sizes.

Briefly stated, this investigation is at the request of the Standards Committee, who have felt the necessity of some specific standard, which could be adopted by all of the automobile manufacturers as well as those in other lines of work could they be made to see the advantages of such adoption. The purpose of this investigation is to determine the relation between strength of bolt or thread and the depth of the latter. Tap manufacturers have for a long time been concerned with the life of a tap and although it may be said in passing that there exists a wide diversity in the cutting abilities, and also the powers required to operate, both of which have a direct bearing upon the life of a tap, there is a serious question regarding the advisability of drilling a hole such as will give a full depth of thread. This is for the reason that although it would be generally conceded a thread of full depth might give more strength than a thread of partial depth, the extra power required in tapping and the attendant probability of breakage are out of all proportion to this slight additional strength. Consequently the desire is to perform actual tests as to the strength of threads of various depths in order to discover a "balance" between this and the life of the tap. There are at present in use in shops throughout the country tap drill sizes which vary from a thread depth of 70 per cent. to 100 per cent. Naturally, this is good cause for an attempt at standardization.

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Pursuant to this idea, the Chairman of this Division has carried on correspondence with those interested and has endeavored to stimulate interest, when needed, in an attempt at co-operation by the manufacturers. Obviously enough, there are many who welcome such a research while there are others who feel quite secure in going their own way. This correspondence has taken much time and has covered much territory, but the Division is glad to report that it is now in receipt of letters from all representative tap and die manufacturers, stating not only their willingness to be of assistance, but their desire to furnish taps for use.

These taps range in size from No. 8 to 1½" by sixteenths of an inch, both U. S. Standard and S. A. E. threads, and are in the process of being received. They are to be sorted and sent to the various members of the Research Division who will obtain material, drill holes giving 100, 90, 80 and 70 per cent. depth of thread, tap the holes in a careful manner so as to provide a fair comparison, and test for strength. The various materials used will range from aluminum to steel, including cast iron and bronze.

Eventually tables will be published and curves drawn which will show the information obtained and a recommendation regarding a standard will be submitted for your discussion, approval and adoption.

Briefly, your committee has accomplished all of the preliminary work incident to this investigation and is now ready to undertake actual testing. The results should be available for submission to you in a reasonable time, bearing in mind that the work which is being contemplated will cover nearly 2,000 tests.

APPLICATIONS FOR MEMBERSHIP

A list of current applications for membership received is given below. The members are urged to send for the consideration of the Council, which under the revised Constitution has jurisdiction of the election as well as the grading of applicants for membership, any pertinent information with regard to those whose names are given which the Council should have prior to the election of any of the said applicants. It is requested that communications from the members in this connection should be sent promptly, in any event before September 28th.

Adams, Charles E., President, Cleveland Hardware Co., Cleveland, O.

Alms, W. E., Field Engineer, Findeisen & Kropf Mfg. Co., Chicago, Ill.

Bliss, Harold N., Chief Engineer, Gas Engine Dept., B. F. Sturtevant Co., Hyde Park, Mass.

Bott, Geo. R., Engineering Manager, Norma Co. of America, 1790 Broadway, New York City.

Bouggy, Clifford M., Assistant to President, J. S. Bretz Co., New York City.

Caldwell, E. deH., Vice-President and Chief Engineer, Empire Axle Co., Dunkirk, New York.

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Cunningham, Dr. Richard R., Chief Electrical Engineer, Splitdorf Electrical Co., Newark, New Jersey.

Curtiss, Carlos W., Secretary and General Manager, Splitdorf Electrical Co., Newark, New Jersey.

Daniels, George E., Vice-President and General Manager, Oakland Motor Car Co., Pontiac, Michigan.

Dorman, A. D., Manager, Chicago District and Warehouse, Union Drawn Steel Co., Chicago, Ill.

George, I. A., Consulting Engineering and Superintendent of Construction, George Automatic Roller Bearing Co., Hamilton, O.

Gildner, H. H., Chief Engineer, S. K. F. Ball Bearing Co., New York City.

Grant, Chas. H., Efficiency Engineer, Page-Fence Co., Adrian, Mich.

Halbfass, Arnold J., Designer, General Vehicle Co., Inc., Long Island City, N. Y.

Hart, William J., Field Engineer, Splitdorf Electrical Co., New York City.

Hawley, Wm. G., Chief Engineer, American La France Fire Engine Co., Elmira, New York.

Kemp, Wm. E., Eastern Distributor, Byrne Kingston & Co. and Kokomo Electric Co., New York City.

Lathrop, T. L., Assistant Body Designer, Buick Motor Co., Flint, Mich.

Lee, Thomas L., Chief Engineer, North East Electric Co., Rochester, New York.

Mann, Howard L., Factory Manager, Chicago Heights Plant, Chicago Pneumatic Tool Co., Chicago, Ill.

Middleton, Ray Trago, Traveling Salesman, Electric Welding Products Co., Cleveland, O.

Moffat, Alex. W., Handling Service on Mercedes Gasoline Trucks, General Vehicle Co., Inc., Long Island City, N. Y.

Murray, C. E., San Francisco Branch Manager, Willard Storage Battery Co., Cleveland, O.

Oberly, Howard E., Superintendent Bearing Dept., Joseph T. Ryerson & Son, Chicago, Ill.

Owen, Raymond M., Capitalist, 735 Seventh Avenue, New York City.

Parker, Clark W., Engineer, Cadillac Motor Car Co., Detroit, Michigan.

Ralph, William I., Vice-President, *Class Journal Co.*, 239 West 39th Street, New York City.

Schaeffer, Henry, Chief Draftsman, Woods Motor Vehicle Co., Chicago, Ill.

Stevens, C. T., Vice-President, Reinhard Bros. Co., Inc., Minneapolis, Minn.

Swartley, Wilmer C., General Sales Agent, Tioga Steel & Iron Co., Philadelphia, Pa.

Van Syckel, Claude S., General Manager, Huston Multiple C. Spring Co., Philadelphia, Pa.

Winckler, Aage E., Consulting Engineer. J. I. Case Threshing Machine Co., (Automobile Dept.), Racine, Wis.

Young, Conrad H., Special Factory Representative, Engineering and Sales, Armstrong Cork and Insulation Co., Pittsburgh, Pa.

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Paper presented at Summer Meeting

ELECTRIC TRANSMISSIONS FOR MOTOR CARS

By Justus B. Entz
(Member of the Society)

Electric transmission systems as applied to motor cars consist of methods of electrically controlling the transmission of the power of the engine to the wheels. It is necessary not only to control and transmit the power but to do so at varying speed and torque ratios while developing the full power of the engine. One method of electric transmission consists of a dynamo or electric generator driven by the engine and supplying electric energy to one or more motors connected with the driving wheels. Another method consists of a dynamo-electric machine connected with or mounted on the driving-shaft and adapted to assist the engine at times of heavy load, drawing its energy from a storage battery, and in turn charging at times of light load, becoming automatically a generator for that purpose and utilizing the surplus power of the engine. The third system is known as the Entz electric transmission, and consists of a dynamo-electric machine, one member of which, the field magnet, is connected to the engine crankshaft and takes the place of the flywheel, the armature being connected with the driving-shaft. This unit serves to transmit the turning effort of the engine to the driving-shaft by means of current established in its circuit, due to a speed difference between its members on what constitutes the high speed of the electric transmission. This speed difference is small, as the armature and field winding is short-circuited upon itself. Any effort exerted by the engine on one of these members, such as the field magnets, must be transmitted in full to the other member or armature which is mounted on the driving-shaft. The arrangement is similar to that in the familiar electric dynamometer used for engine testing, in which the torque of the engine is measured by rotating one member by the engine and leaving the other free to revolve around its center but restraining it by an opposing resistance such as a spring balance or scales which measures its effort to turn and therefore the turning effort of the engine. This clutch-generator of the electric transmission constitutes a very elastic clutching and transmitting means, but is not by itself capable of transmitting more than the torque of the engine. For higher torque upon the driving-shaft, use is made of an electric motor whose armature is mounted upon the driving-shaft and which receives current from the first machine or clutch-generator. Thus on speed positions below the highest the motor is included in the circuit of the clutch-generator. If the windings of the two machines be the same, and the same current passing through each, the

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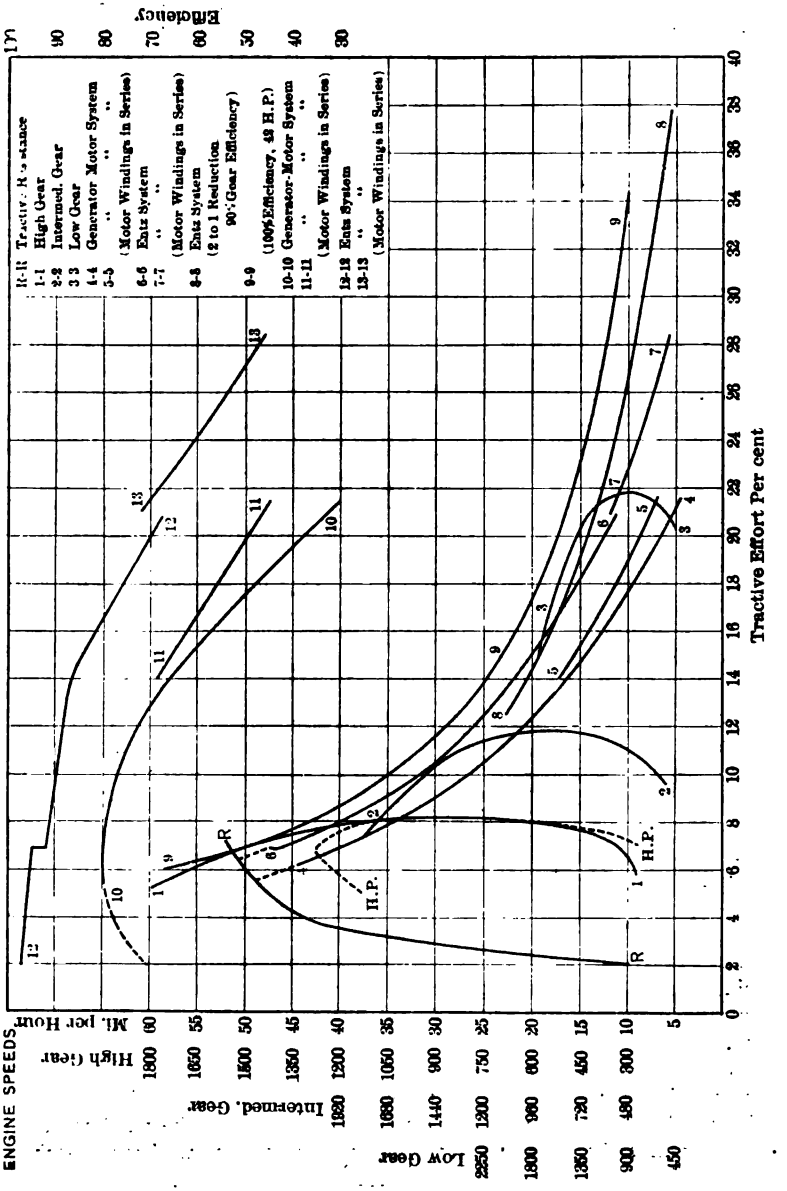
torque represented by that current which will be the same in each, and the electromotive-force will be the same in each for the same speed-difference between armature and field.



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Thus if the full torque of the engine were transmitted for a slip or speed-difference between armature and field of the clutch-generator of 75 r.p.m., and the motor with the same electrical resistance were included in the circuit, the slip loss would be increased to 150; if the engine were running at 1500 r.p.m. the speed representing useful power would be 1350 r.p.m. at engine torque; but the torque on the driving-shaft will have been doubled because of the motor, and a C.E.M.F. all will have been set up in the motor, which must be overcome by the clutch-generator, which results in a speed of 675 of the driving-shaft and a torque double that of the engine, the clutch-generator then having a slip of 825, 150 being due to the resistance of the clutch-generator and motor and 675 to overcoming the C.E.M.F. of the motor, the latter representing useful work in the return it gives to the driving-shaft in additional torque. Gradations of control in speed and torque are secured by means of varying the field strength of the clutch-generator and motor, as will be shown later on.

In order to make a comparison of the different methods of the transmission and control of the power of a gas engine to the driving-wheels of an automobile I show a few curves giving the characteristics of each type. These show the speed of the vehicle for different tractive efforts expressed in percentage of weight of car. In the case of the mechanical transmission, curves are shown for three different gear ratios, the intermediate being 1.6 times the reduction of the high and the low 3 times. The intermediate and low have been taken at 90 per cent. efficiency and the high at 100 per cent. efficiency. The speeds and tractive efforts shown correspond to those of a car of 4,700 pounds loaded, with 3¼ reduction on high and 36″ wheels.

The engine has a maximum horsepower of 42.5 at 1,500 r.p.m.

Referring to curve *1-1*, showing the performance in speed and tractive effort on the high gear of the mechanical transmission, if the resistance to motion on the level be as shown by curve *R-R*, the maximum speed would be 51 miles per hour, and the maximum grade that could be climbed 5 per cent., at speeds between 15 and 30 m.p.h., the climbing ability falling off at speeds above and below these points. As the engine commences to fall off rapidly in torque at speeds below 300 r.p.m., corresponding to 10 m.p.h., it becomes necessary to shift to a lower gear, in which case tractive efforts and speeds are obtained corresponding to those shown by curve *2-2* for intermediate gear, and curve *3-3* for low gear. On high gear the tractive effort at 1,500 r.p.m. is 6.9 per cent. and the maximum 8.1 per cent. at 900 r.p.m.

We will now consider the electric transmission of the engine power to the wheels and make a comparison between a generator-motor system, wherein the generator converts all of the power of the engine into electric energy and supplies it to the motor, and the Entz electric transmission system wherein the generator acts also as a clutch and converts only part of the engine power into electric energy, and only when in the lower speeds.

The electric energy equal to the maximum horsepower of 42½ at

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1,500 r.p.m. is 31,700 watts. We will consider that the same electrical units are used in each of the two above-mentioned systems. We will call the current which represents the full output of the generator at full field strength 100 per cent. We will call the C^2R loss at this current 2½ per cent. of the total input, for each armature and each field winding, and the core losses for full field strength and full speed difference 5 per cent. in each armature. The first losses vary as the square of the current and the core losses nearly as the square of the voltage, or the product of the field strength and speed, to which the voltage is equal.

In the generator-motor system with 100 per cent. current we have 2½ per cent. C^2R loss in each armature and field winding or 5 per cent. in generator and 5 per cent. in motor, a total of 10 per cent., which appears as a speed loss as it lowers the effective voltage by that amount, so that the vehicle speed is reduced from 50 m.p.h., corresponding to 1,500 r.p.m. of the engine, to 45 m.p.h. There is also 5 per cent. core loss in each armature or 10 per cent. total, corresponding to a reduction in tractive effort from 6.9 to 6.2 per cent. The total efficiency is 80 per cent.

In the electric transmission system the full torque of the engine is transmitted by the generator unit alone, short-circuited upon itself, and with no torque loss, but with a C^2R loss of 2½ per cent. in each armature and field, or 5 per cent. total, giving a speed loss of 2½ m.p.h, resulting in a speed of 42.5 m.p.h. at 6.9 per cent. tractive effort. To get double the torque on the driving-shaft with the generator-motor system, the current through the motor must be increased and supplied by the generator, which must have its voltage proportionately reduced. If we double the current, or make it 200 per cent., we will increase the torque about 2¼ times, equal to 14 per cent. tractive effort. The C^2R loss in the generator armature then is 2.5×4 — equal to 10 per cent. As the generator field is weakened the loss in it is reduced to 1 per cent.

The C^2R loss in the motor armature is 10 per cent.

The C^2R loss in the motor field is 10 per cent.

The combined core loss in the two armatures is 2½ per cent.

The total loss is 33⅓ per cent.

The efficiency 66⅔ per cent.

The vehicle speed at 14 per cent. tractive effort and 66⅔ efficiency is

$$50 \times \frac{6.9}{14} \times .665 = 16.4 \text{ m.p.h.}$$

To get double the torque with the electric transmission it is not necessary to increase the current, but the motor is included in the circuit of the clutch-generator and its torque added to that of the engine as transmitted by the clutch-generator and the latter slips a little more than one-half engine-speed to supply the necessary voltage for the motor.

The C^2R loss in the generator armature and field is	5	per cent
The C^2R loss in the motor armature and field is	5	" "
The core losses in the two armatures is	2.5	" "
Total loss	12.5	" "
Efficiency	87.5	" "

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As there is 2.5 per cent. core loss which is equivalent to friction, the tractive effort will be 2.5 per cent. less than double the engine torque, or $6.9 \times 2 \times .975 = 13.5$ per cent.

The speed is $50 \times \frac{6.9}{13.5} \times .875 = 22.5$ m.p.h.

To get three times torque with the generator-motor system we will figure on 300 per cent. current and 3½ times torque of 100 per cent. current.

The C^2R loss in the generator armature is	$2.5 \times 9 =$	22.5	per cent.
The C^2R loss in the generator field is		.75	" "
The C^2R loss in the motor armature and field is	$5 \times 9 =$	45.0	" "
The core loss in both armatures is		2.0	" "
Total loss		70.25	" "
Efficiency		30.0	" "

Torque $6.2 \times 3.5 = 21.5$ per cent. tractive effort.

Speed is $50 \times \frac{6.9}{21.5} \times .30 = 4.8$ m.p.h.

To get three times torque with electric transmission we must double the current through the motor and reduce the field strength of the clutch-generator to one-half so that it can deliver double current.

The C^2R loss in the generator armature is	$2.5 \times 4 =$	10	per cent.
The loss in the generator field is		1	" "
The C^2R loss in the motor armature and field is	$5 \times 4 =$	20	" "
The core losses in both armatures is		2	" "
Total loss		33	" "
Efficiency		67	" "

The tractive effort is $6.9 + 14 = 20.9$ per cent.

Speed is $50 \times \frac{6.9}{20.9} \times .67 = 11.1$ m.p.h.

The higher tractive efforts can be obtained in either system at a better efficiency by providing the motor armature with two windings and two commutators and putting them in series for maximum tractive effort. For example, in the generator-motor system for double the torque we can keep the current output of the generator at 100 per cent., the same as for full torque, and put the two windings of the motor in series, getting 14 per cent. tractive effort, and a generator loss of 5 per cent. C^2R and 5 per cent. core loss and a motor C^2R loss of 20 per cent., as the resistance of the motor windings has been increased by four times by putting them in series, and the motor core loss of 1¼ per cent.; total loss, 31¼ per cent.; efficiency, 68¾ per cent.

For 1½ times current we get a tractive effort of 21.5 per cent. with the

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motor winding in series, the same as we got before with three times current.

The generator C^2R losses in armature and field are	7.0 per cent.
The motor C^2R losses are	45.0 " "
The core loss in both armatures is	3.5 " "
Total loss	55.5 " "
Efficiency	44.5 " "

In the electric transmission system if we put the motor winding in series the current will not have to be increased over full-load current for three times torque, and we will get a tractive effort of 6.9 plus 14 = 20.9 per cent.

The C^2R generator loss is	5.0 per cent.
The C^2R motor loss is	20.0 " "
The combined core loss is	3.5 " "
Total loss	28.5 " "
Efficiency	71.5 " "

TABLE I

ELECTRIC TRANSMISSION SYSTEM

					Motor Windings in Series	
Current	100%	100%	100%	200%	100%	150%
Gen. C^2R Arm	2.5	2.5	2.5	10.0	2.5	5.62
Gen. C^2R Field	2.5	2.5	2.5	1.0	2.5	1.38
Gen. Core Loss	0	1.0	1.25	1.0	2.5	1.00
Motor C^2R Arm	0	2.5	2.5	10.0	10.0	22.5
Motor C^2R Field	0	1.0	2.5	10.0	10.0	22.5
Motor Core Loss	0	1.0	1.25	1.0	1.0	1.0
Total Loss	5.	10.5	12.50	33.0	28.5	54.0
Efficiency	95.	89.5	87.5	67.0	71.5	46.0
Tractive effort	6.9	10.2	13.5	20.9	20.9	28.4
Speed	47.5	30.5	22.5	11.1	12.	5.75

Tables (1) and (2) show the losses, efficiency, tractive effort and speed for both the generator-motor system and the electric transmission system.

In practice I prefer not to use the series arrangement of the motor winding, as sufficient maximum torque is provided without it, for every condition of road and grade usually met with. Moreover, if forced into it for long length of time, as climbing a mountain grade five or more miles long, the heating of the motor would be excessive. As we use a mechanical reverse, the use of one more pair of gears in the reverse gear-box allows us to get a double-reduction between driving-shaft and wheels.

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TABLE II

GENERATOR-MOTOR SYSTEM

					Motor Windings in Series	
Current	100%	150.	200.	300.	100.	150%
Gen. C^2R Arm	2.5	5.62	10.	22.5	2.5	5.62
Gen. C^2R Field	2.5	1.38	1.	.75	2.5	1.38
Gen. Core Loss	5.0	2.50	1.25	1.00	5.0	2.50
Motor C^2R Arm	2.5	5.62	10.0	22.50	10.0	22.50
Motor C^2R Field	2.5	5.62	10.0	22.50	10.0	22.50
Motor Core Loss	5.0	2.50	1.25	1.00	1.25	1.00
Total Loss	20.0	23.25	33.5	70.25	31.25	55.5
Efficiency	80.	76.75	66.5	30.0	68.75	44.5
Tractive Effort	6.2	10.0	14.	21.5	14.	21.5
Speed	45.0	26.5	16.3	4.8	17.2	7.0

We still use electric control for all manipulations of the car, but have every control position giving double tractive effort, and a range of control not possessed by any other system.

Curve *4-4* shows the speeds and tractive efforts of the generator-motor system. Curve *5-5* shows the same with the motor windings in series.

Curve *6-6* refers to the electric transmission, and *7-7* the same with the motor windings in series. Curve *8-8* shows a 2:1 greater reduction with the electric transmission, the gears being taken at 90 per cent. efficiency.

Curve *9-9* shows the speeds and tractive efforts corresponding to the full power of the engine, 42.5 H.P., with no loss.

Curve *10-10* shows the efficiency of the generator-motor system and *11-11* the same with the motor windings in series. Curve *12-12* shows the efficiency of the electric transmission and *13-13* the same with the motor windings in series.

These efficiency and performance curves are for the maximum horsepower of the engine, that is with wide-open throttle at 1,500 r.p.m. The gasoline economy, however, is decided by the efficiency at about 25 m.p.h. and 3 per cent. tractive effort. In this case with the generator-motor system, we may assume 60 per cent. current and 80 per cent. motor field-strength, equal to 3 per cent. tractive effort, and can call the work done 20 per cent. of the maximum horsepower, which is equal to 20 per cent. of 31,700 watts or 6,300 watts. The generator will have full field-strength and 2½ per cent. loss. The generator armature will have a C^2R loss of $2.5 \times .6^2 = .9$ per cent. The C^2R loss in motor armature and field will be $5 \times .6^2 = 1.8$ per cent. The core losses in both armatures equals 2.5 per cent. The total losses are equal to 7.7 per cent. of the maximum power, which is equal to 2450 watts, making a total input 8,750 watts and the

efficiency $\frac{6.3}{8.75} = 72$ per cent.

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In the case of the electric transmission the current would be reduced to correspond to the reduction from 6.9 to 3 per cent. tractive effort, or from a slip of 5 to 3 per cent. at 1,500 r.p.m., which would be equivalent to 6 per cent. slip at 750 r.p.m., or 94 per cent. efficiency.

Referring to the efficiency curve it will be seen that up to the point where the engine is fully loaded in the high-speed position in the electric transmission system only one electric unit is in service, and that has only the losses due to resistance or what are known as C^2R losses; while the generator-motor system has both units in service and the C^2R loss of both, as well as the core losses of both, equalling a loss four times as great, as well as a reduced output due to the greater losses. Again, with exactly similar electric units used in each system the C^2R losses are the same in each when both units are in use, and the same current is used. In the generator-motor system both units are used and full current for 6.2 per cent. tractive effort, and the total loss is 20 per cent., 10 per cent. C^2R loss and 10 per cent. core loss. In the electric transmission system both units are used with full current for 13.5 per cent. tractive effort, and we have 10 per cent. C^2R losses, but only 2.5 per cent. core loss, as the speed-difference between armature and field of generator and motor is but one-half of what it is in the generator-motor system.

Again, with double current in the generator-motor system we have 14 per cent. tractive effort, the C^2R loss is 31 per cent. and the core losses 2.5 per cent. In the electric transmission system double current is at 20.9 per cent. tractive effort, the C^2R losses are 31 per cent. and the core losses 2 per cent. It will be noted in this last case, where the difference in core loss is small, that the difference in tractive effort for the same current is the torque of the engine as transmitted through the clutch generator, 6.9 per cent. The additional torque transmitted by the electric transmission over the generator-motor system with the same current in the units of each is the torque of the engine, plus the gain due to reduction in core losses. Also, as all energy loss appears as heat which causes a rise in temperature of the electric units, the size and weight of the units comprising the electric transmission system are very much reduced as compared with the generator-motor system.

In reference to the other electrical system, using a motor on the driving-shaft to help the engine at times of heavy load, the electric motor assists the engine driving-effort in the same way as the motor in the electric transmission does, but the storage battery takes the place of the clutch-generator in supplying current to the electric motor. In this case the engine and electric motor must run at the same speed, as they are on the same driving-shaft, and unless an excessive weight of battery is carried it will be possible to add much additional driving effort only when the vehicle speed is low. If at 10 m.p.h. there is added 7 per cent. tractive effort to the 7 per cent. exerted by the engine, we have an output of $42.5 \times \frac{10}{50} = 8.5$ H.P. Assuming the efficiency of the motor at this low speed is 70 per cent., we would require 12.2 H.P. input or 9,000 watts. The lightest form

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of thin-plate high-discharge-rate storage battery gives 15 watts per pound when discharged at a rate that would empty it in 15 minutes. This would weigh 600 pounds, and automatic means would have to be provided to balance the input and output of the batteries. In the case of the electric transmission system the same electric energy is supplied to the motor for a speed-difference of the clutch-generator of 450 r.p.m. In other words, with the electric transmission and the engine running at 750 r.p.m. we supply continuously to the motor what would exhaust a 600-pound battery in 15 minutes with the engine running at 300 r.p.m., the car speed and tractive effort being the same in each case.

The sectional view of the Entz system given herewith shows the crankshaft, to which is attached what is designated the clutch-generator, which has its field part *FR*, which carries the field winding *FW* and the pole-pieces *PP*. This field portion of the clutch-generator rotates whenever the crankshaft rotates. Within it is the armature *A* secured to the shaft *S*, which is continued rearward through a coupling *K* into another shaft *S*, and this in turn connects through a universal joint at *X* with the propeller-shaft of the rear axle.

The second part of this electrical unit is shown in the right end of the illustration, and is in all respects a duplicate of the clutch-generator shown at the left. This electric motor has an armature *A1* carried on the shaft *S*, so that both the armature *A* and *A1* are on the same shaft. Outside of the armature *A1* is the usual field part of the motor, comprising the field rings *FR*, field windings *FW*, pole-pieces and the usual brushes *B*.

The field *FR* can revolve and the armature *A* on its shaft *S* remain stationary. The field *FP* may revolve at a speed of 1,500 r.p.m. and the armature *A* at a speed of 500 r.p.m., giving reduction for low speeds. It is by varying the relative speed of the field *FR* and the armature *A* that speed-changes are accomplished. The manner in which the system works is as follows: On direct drive the clutch-generator is short-circuited on itself and rotates the armature *A* with it. There is, however, a slight slippage between the field *FR* and the armature *A;* if the motor were working at 1,000 r.p.m. the armature would be turning the propeller-shaft at approximately 960 r.p.m. In other words, there is a loss of 40 r.p.m. per 1,000 with the car running on a level road. If the car were mounting a heavy hill, when the engine would have to pull more, the slippage would increase slightly. The reduction in forward speed is accomplished by making the slippage between the field and armature more; thus on low speed the field may be revolving 1,000 r.p.m. and the armature 250.

The changing of speeds is controlled entirely by a small lever on the steering-wheel. This lever is also used for starting the engine, it being only necessary to move it upward to the starter position. When changing from one speed to another it is moved a little more than an inch. In changing speeds there are no mechanical jumps as in sliding gearsets but one speed works into another imperceptibly.

The electric motor performs some functions in addition to that of assisting the gasoline engine to do its work. It serves as an electric brake, gradually reducing the speed of the car when the controller lever is placed

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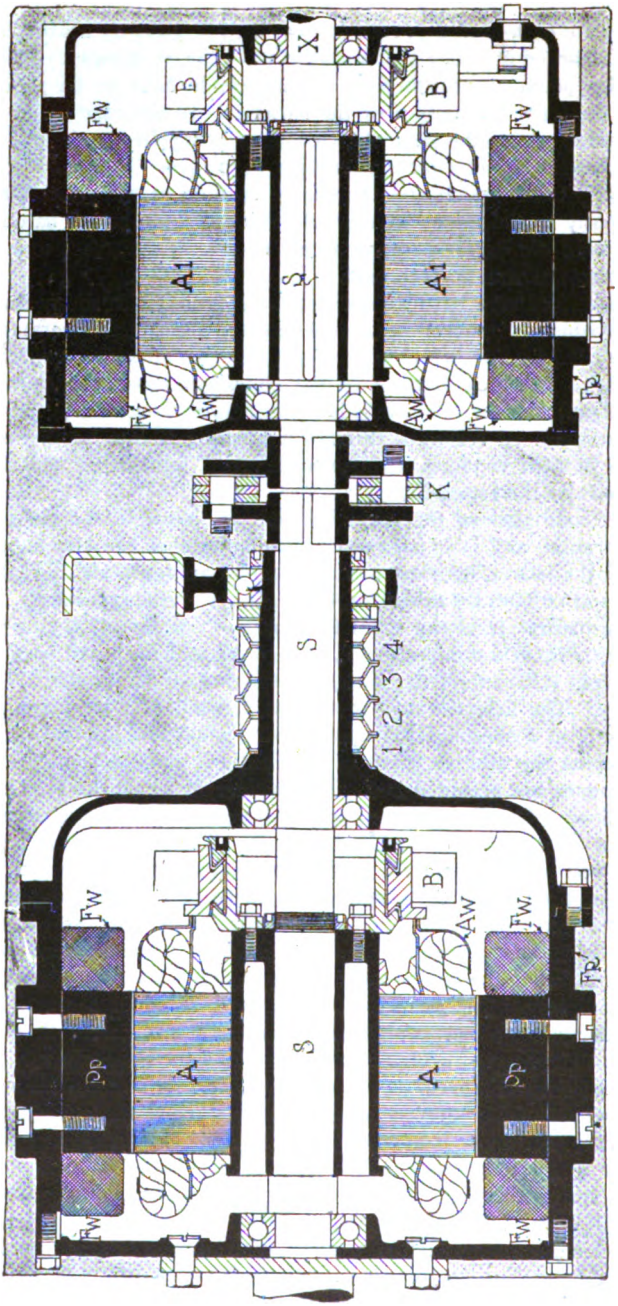

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in a neutral position. It also charges the storage battery at a 10 ampere-hour rate when the direct drive is used. There is a still further position of the controller lever which gives a charging rate of 30 amperes, which is useful after the car has been idle for some time or in emergency.

Discussion at Detroit Section Meeting

PNEUMATIC GEAR-SHIFTING

W. D. BURFORD:—In designing a mechanically operated gear-shifting device for selective-sliding gear transmission, we are confronted by several interesting problems. First, there must be no chance of any gear being brought into mesh while the clutch is engaged. Second, the device must be positive as to the selection of the gear ratio desired. Third, it must shift the gears at a speed that will prevent clashing while the disengaged gears are rotating. Fourth, its operation must require little or no effort on the part of the driver. Mr. Gray has overcome the first problem, that of not engaging any gear while the clutch is seated, in a very simple manner. He connects the valve control direct to the clutch pedal in such a manner that the pedal has a free movement until the clutch slips, after which the first port action occurs, admitting air to the front end of the cylinder. This drives the piston back, throwing all or any gears into neutral. Then as the clutch pedal pushes further another set of ports is opened, closing the first set and admitting air to the opposite end of the cylinder, driving the piston back and selecting whatever gear the selector is connected with at the time. We connect the gear with a lever on a quadrant mounted just below the steering wheel in a position where it is reached readily by the fingers. The lever is shifted to any position excepting reverse without touching the button.

We use a tank, in some cases 11″ x 33″, in the rear of the car; where we put it underneath the body we use a 7″ x 48″ seamless steel tank, tinned inside and out. At present we are using the Kellogg pump, and the O. B. pump of Minneapolis. We find the O. B. pump gives very good satisfaction. We advise a pressure of not less than 50 pounds in the operation of the device. With the Michigan forty that I am driving a good deal the pressure frequenty runs down, however, to 25 pounds, the device operating with perfect satisfaction. I have operated with a pressure up to 300 pounds, which simply gives a little snappier action. We have been asked frequently what would we do if we lost air pressure. We have worked out an emergency device that covers that very satisfactorily; a lever carried in the tool-kit to be used if necessary by dropping through a hole in the footboard, engaging a slot, actuating the piston mechanism. Mr. Gray drove a machine with one of the devices for

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29,000 miles through the West, in the mountains and out through Canada, and never had to resort to the emergency lever. If he had had a tank puncture he would have had to use it.

ERNEST R. FRIED:—Can you explain why the gears should not clash?

W. D. BURFORD:—I cannot. Whether it is because of the extra speed at which the machine operates, I do not know. Men who have told me they were chronic gear strippers have used this device and you could not hear hear them get away. We pipe the exhaust into the muffler, if desired. We have equipped about 150 used cars, aside from the demonstrators we have put out, mostly in Illinois and Iowa. The men who drive them say the device is practically fool-proof. Outside of the operation of selecting the gear you want, it is practically automatic.

A. W. COPELAND:—Is it always positive? Can you throw the clutch out too quickly and pass the neutral opening?

W. D. BURFORD:—We had a little trouble with that in the second type of machine we put out. We found that the first set of ports passed too quickly; that a green driver, for instance, would jam the clutch quickly and sweep past neutral. We elongated the hole so that the port had a longer time to pass.

A. W. COPELAND:—It is not possible now to miss shifting the gear?

W. D. BURFORD:—I have tried to make the device miss and have not succeeded. We have had men not used to driving an automobile get in and watched to see if they could make it miss. I have never seen the device fail, providing the air pressure was above 25 pounds, with a transmission in proper order. I have seen one or two cars in which the gears did not shift very well at 40 pounds pressure. We found the transmission was not in good condition. Most of our experience outside of some twelve or fourteen cars, has been with used cars; some were regular arks.

CHAIRMAN E. T. BIRDSALL:—Con you set the lever for any shift before you want to shift?

W. D. BURFORD:—Yes. Suppose you are in third; you can have the indicator back at reverse and it will not make any difference. It would not be advisable to do that, however. The location of the lever has absolutely nothing to do with the gear that is in mesh, until after the clutch pedal is depressed. The minute you push the clutch pedal in, you go to neutral, and as you go on through get whatever gear is indicated on the selector.

We have got some pretty steep hills in our region. I drive with the indicator lever set on second all the time. If I am running on third, the minute the motor commences to labor I shove the clutch pedal in and I am on second. If I think I will have to go to first, I shove the indicator lever down and leave it there; when I can no longer run on second, I push the clutch in again and go to first.

ALLEN LOOMIS:—Does this method of shifting gears cause any wear on the gear teeth?

W. D. BURFORD:—It causes considerably less than the present method of shifting, because the shock is taken on the ends of the piston. With

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the air cushion there is not as much slamming as in the present method of shifting. When the shift starts, it goes in with a "bang." You get no clash and do not burr the gears as in shifting by hand.

ALLEN LOOMIS:—If all the gears go to neutral every time the clutch is thrown out, does this not tend to cause more wear on the end of the gear teeth?

W. D. BURFORD:—I presume it would, theoretically. All we have to go by is our practice. I personally examined the transmission that made 29,000 miles, and found it in better condition than the conventional transmission in my car which has run only 11,000 miles. I think I am not a hard driver either.

I have gone from third to first scores of times with the pneumatic device with perfect success, never failing once.

GEORGE W. DUNHAM:—If the car was going at any considerable speed when that was done, it would give the passengers the sensation of having the brake applied.

W. D. BURFORD:—Of course, it would throw me almost to the dash if I put the clutch back quickly.

CHAIRMAN E. T. BIRDSALL:—On a car with rear-axle transmission, would you place the device on the transmission?

W. D. BURFORD:—Integral with the transmission case, wherever it is, in original installation. We equipped a Marmon car recently, putting the device amidships, carrying the rods back to the rear axle.

Mr. FLEET:—How many valves are necessary?

W. D. BURFORD:—We have one main valve which has a rubber composition seat; an ordinary poppet valve lifted by a bell-crank in a sliding rod pulled by the clutch pedal. The ports are controlled by a sliding valve, which is like a Corliss valve,acting merely as a distributor. The main valve will hold 200 pounds of air. We used to have a sleeve valve, but it is not necessary. We think we have the proper valve for air at the pressures we are using, not a metal valve.

CHAIRMAN E. T. BIRDSALL:—The tank seems very large. Could that not be reduced? The 11" x 33" tank must weigh 40 or 50 pounds.

W. D. BURFORD:—The reason we are using that tank is that we are combining with our equipment a rotary starter. It is a much larger tank than is necessary for the gear-shifting. I put on two or three pneumatic gear-shifts with a tank the size of a Prestolite tank. Of course, in that case you have to run the pump oftener.

C. C. HINKLEY:—Have you automatic control on the pump to maintain pressure?

W. D. BURFORD:—We are trying a diaphragm control now. Four or five of them, in the experimental stage, are being tried out. We turn the air on at 100 or 125, and turn it off at 175.

STEPHEN I. FEKETE:—How many ports are there?

W. D. BURFORD:—One central cylinder operates the whole machine. Two ports are drilled into that. The sliding valve, which is nothing but

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a rod, a screw machine product turned up oversize and ground, has five grooves in it; one of these grooves operates the bell crank, and the others act as circular ports.

A MEMBER:—How much weight do you add to the car?

W. D. BURFORD:—One hundred and twenty pounds, including the Thurber motor starter. The shift itself weighs 20 pounds; less than that as a factory proposition. You can have it in front or back of the transmission. That is why the rods are slotted on both ends. With an ordinary amidships transmission, where we get behind the transmission, we simply cut the rods off at the back end.

A MEMBER:—What is the diameter of the piston valve?

W. D. BURFORD:—Two inches. The total stroke is 1/16". That is fixed. We have yet to find a case where we could not shift with this stroke. We multiply with shifting fingers on a sleeve or bell-crank, according to the condition we have to meet.

CHAIRMAN E. T. BIRDSALL:—If it was built in the transmission?

W. D. BURFORD:—We would have to change the design.

CHAIRMAN E. T. BIRDSALL:—Then you would make the stroke to suit?

W. D. BURFORD:—Yes.

ERNEST R. FRIED:—You have a good-sized tank. You have the shifting device. The operation is just about the same as the operation of the present gear-shifting device. You have to push out the clutch, you have to move a lever; whether the lever is short or long does not make much difference. The effort to shift gears with the hand lever is not great. You add a good deal of weight to the car; you add more mechanism; it is more liable to get out of order, and cost more.

W. D. BURFORD:—You are going on the theory that the present method of shifting gears is good enough?

ERNEST R. FRIED:—I do not see why we should use such an automatic gear-shift.

W. D. BURFORD:—The present method of shifting gears does more to keep people from using cars than any other one thing.

CHAIRMAN E. T. BIRDSALL:—Have you put the device on a four-speed box? On some four-speed boxes you go through the first into reverse. Can you do that?

W. D. BURFORD:—No, we cannot go through; we have to have five slots.

CHAIRMAN E. T. BIRDSALL:—You have to have three shifting levers?

W. D. BURFORD:—Yes; we cannot handle the progressive type of sliding-gear transmission with this device.

CHAIRMAN E. T. BIRDSALL:—On a car already in use, what does it cost to install the device?

W. D. BURFORD:—Our agents sell the equipment, including a pump, tank and shift, for $200.00. It costs about $12.00 to $20.00 to put it on a used car. That has been our experience. We pay 40 cents an hour for labor.

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M. A. SMITH:—Do you install the device without a motor starter?

W. D. BURFORD:—Yes. We have a 7" x 30" tank that we furnish for an electric-starter equipped car.

E. V. RIPPINGILLE:—Have you had any experience with the device working in zero weather?

W. D. BURFORD:—The one referred to has been driven two winters. It was 37 below zero in Wisconsin at times. The car was driven every day without a bit of trouble.

E. V. RIPPINGILLE:—At what pressure was it operating then?

W. D. BURFORD:—About a hundred.

CHAIRMAN E. T. BIRDSALL:—Mr. Burford, or his company, has had the same experience that everybody has had in holding compressed air at high pressures. That is, a rubber-seated valve is the only thing that will hold it. I had about a year's experience with that. While I hated to use rubber or anything of that sort, yet I was forced to do so. Rubber will absolutely hold the air. Nothing else we could find will. With just enough rubber in a composition to hold a seat, we have had seats with brass chips in them, which still held the air. All the air-brake people, and everybody using compressed air, have all come to some such material for the valve; that is, where they expect to hold air without leakage. In the matter of piping joints, it is simply a question of making them large enough, and screwing them up hard enough. On my car I solder everything from one end to the other. It is very easy to break a soldered joint on a good heavy coupling. If the joint is sweated full of solder you know that it is air-tight.

SECRETARY H. L. CONNELL:—To what pressure are the tanks tested, to be sure there is no danger?

W. D. BURFORD:—Six hundred pounds.

SECRETARY H. L. CONNELL:—Is the pump so arranged that there is no danger of going up to that pressure, or do you simply control it by reading the pressure gage when shutting off the pump?

W. D. BURFORD:—Our automatic control will take care of that. That is still in the experimental stage.

CHAIRMAN E. T. BIRDSALL:—If Mr. Burford has had the same experience with automatics we have had he will continue the use of some plain foot pedal. It is a very simple device, and never fails to work when you push it or trip it.

W. D. BURFORD:—As for getting the pressure up to 600, we have not yet found any pump that will do that.

SECRETARY H. L. CONNELL:—Would there be any danger of disastrous results if you should hit a loose plank going over a culvert, or something should hit the tank?

W. D. BURFORD:—We had a case where the reach-rod clashed on the tank. The tank was not put on properly. After it had been on about a month I found a dent in it over ¼" deep. The tank was not impaired in any way.

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SECRETARY H. L. CONNELL:—Those are steel tanks?

W. D. BURFORD:—Yes, seamless steel tanks.

SECRETARY H. L. CONNELL:—I have always wondered why the Pierce-Arrow company in particular discarded the position of the gear-shift lever under the steering-wheel. It seems to be a very natural position. Was it because there was not enough leverage? Of course, that would not affect this case, because you have very little work to do.

CHAIRMAN E. T. BIRDSALL:—That was changed simply through the demand of the agents for the side lever. I have used cars with the gear-shift lever under the wheel. The old Darracqs had it there. There never was any trouble at all about leverage. It is a good gear-shift, but you can not sell a car with it on.

AIR PUMPS

E. J. THURBER:—Our experience with air pumps has been quite broad, and we have come to the conclusion that the principal reason that they have not been developed any further than they have is because they have not been made in accordance with the work they are supposed to do. We think we have a pump that will hold up indefinitely now. We are able to get as high as 500 pounds without the operation of the pump on the car being perceptible. We designed a pump in which instead of a crank we have a 2″ drop-forged eccentcir, case-hardened. We get a perfect bearing, practically indestructible. We also arranged a lubrication system which is practically the same as the splash system on automobiles. The pump proposition has been almost as serious as holding the air after you get it. Our starter to-day is built with the pump as an integral part, and forms a unit-powerplant. The plant can be attached to a factory proposition similarly to the way the electric starters are attached to-day, and take about half as much room.

Another thing about the pumps has been the construction and angle of valve. Judging from the pumps we have inspected, about seventy-five made in this and foreign countries, you would be surprised to see the way people have struggled to hold the air after they got it on top of the cylinder; the different clearances. I believe we use an angle of 26 degrees on the valve, which is the only angle that will hold the air constantly. We find that with 30 degrees you can hold it for about two weeks, and then it is all off. Then again we find that by case-hardening a valve with a cast iron seat better results are attained. I think the air starter is going to be the thing. I have been in the automobile business about ten years, and our engineer has been in it ever since automobiles have been built, and we do not know what to do with the electrical equipment. We have been able to hold air, at 300 pounds pressure, six months just in the valve. If you get a valve with a small check in it, you will have a tremendous amount of heat when running at 800 r.p.m. Our pump has about a 1″ ball-check.

CHAIRMAN E. T. BIRDSALL:—One feature of the pump business that has not been touched on, is the making of a good pump for $5.00.

E. J. THURBER:—I think you will not find a good pump for $5.00.

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CHAIRMAN E. T. BIRDSALL:—It is very easy to make a good pump for $25.00, but awfully hard to make one for $5.00.

E. J. THURBER:—I understand that one motor builder is making a seven-cylinder motor, or rather a six-cylinder motor, cast it in threes, with about a four-inch pump between. He is figuring on having plenty of air all the time. He is on the right track.

SECRETARY H. L. CONNELL:—I understand with this combination starter and shifter you do not have the trouble with lubrication that one does in getting air pressure for gasoline tanks; that is, it does not make any difference if you do shove oil over; on the other hand, it is an advantage.

W. D. BURFORD:—It is an advantage.

E. J. THURBER:—It is an advantage in our system, especially with a gear-shifting device. We used to be troubled with too much oil in the starting system; instead of being now a serious drawback to us, it helps us out materially, because after you once put the starter on absolutely no instructions as to the lubrication are necessary because it is self-lubricating. On the bottom of our valve there is a trap; the oil goes into that trap from the pump, and the minute you open the valve, it goes into the starter. For tire-inflation we avoid getting the oil into the tires.

SECRETARY H. L. CONNELL:—Has any difficulty arisen from too much oil getting into the air tank; that is, in time making a gummy mass?

E. J. THURBER:—No, in the construction of our valve instead of the air going into the tank direct it is received from the bottom of the valve, in which there is an oil trap of sufficient capacity to take care of as much oil as you would pump in there in a week; the minute you open the top of the valve, the oil that is in there rushes right into the starter. It is for that reason we have absolutely no trouble in cold weather, because any condensation would go in through the trap. There is no occasion for a drainplug in the trap. We have tested repeatedly for water and oil out of the tank, and found absolutely none.

Presented at Indiana Section Meeting.

THE TENDENCIES IN BODY DESIGN

BY HINSDALE SMITH*

(Member of the Society)

Body design is a matter of both utility and appearance. I believe that the present tendencies are toward the greatest efficiency and that the automobile body of the future will be evolved along this line. In seating arrangements we have observed a tendency toward the Sedan style in touring cars, using one very wide door on each side in the rear of the front seats, the front seats having a passageway between them or one of them being made to fold up to the side of the body. This is a practical arrange-

*President Springfield Metal Body Company.

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ment and in the case of five-passenger cars a very useful design. The doors should be at least 25" wide. The body should be made for somewhat less money than when four doors are employed. In small bodies particularly, with the four-door arrangement the doors have to be made too narrow where a deep cowl is employed. With the two-door body the cowl may be made very deep, giving plenty of room for a large gasoline tank where this is desired. The door is also placed forward of the rear fenders, making it much easier to enter when the top is raised. The same idea might be carried out with seven-passenger bodies, but I believe its usefulness is confined to the smaller type.

There are numerous instances of bodies having a tire-compartment in the rear; the tires being placed in the body by removing a panel in the back of the rear seat, in which case the tire is carried in a vertical position. In several recent foreign designs the tires are carried horizontally on the floor of the car, lying under the rear seat, occupying the lower portion of the extended back end of the body. In these cases the rear end of the body is of the streamline form. On cars having the gasoline tank at the rear it is not easy to conceal the tires in the back of the body. The use of the dash tank where it can be arranged to be of sufficient capacity is of value in this connection.

There is an increasing tendency abroad to devise some means of concealing the top in the body when it is not in use. Numerous new designs are appearing and the development should be watched with considerable interest. Those I have so far inspected are rather crude when the top is in use, there being a very unsightly opening left at the back of the rear seat. Several designs have appeared recently in which the body is fitted with removable lids which are opened when the top is being raised and closed when it is up. These are fairly successful on narrow bodies but not satisfactory on bodies having room for three on the rear seat.

It is a matter of common knowledge that nearly all new body styles originate in Europe. Why this should be can be understood clearly when it is considered that a customer there wishing a new car buys the chassis separately, which he takes to the body builder who builds specially to individual requirements. In this way there is an endless chance for experiment; each body incorporating new ideas and improvements. A single body builder has the opportunity of building hundreds of new designs in a year, whereas in this country a manufacturer builds thousands of only two or three designs. For this reason it is most necessary to watch the bodywork being done abroad. Many new designs appearing crude to us at present will in the course of a year or so be perfected and modified to give pleasing and practical results. It must be borne in mind that not all designs which look well on foreign chassis appear equally well on ours, as the foreign chassis are built lower and have better body space. In the past the American engineer has been prone to skimp the space behind the dashboard in order that his engine be not crowded, forgetting that he is building a carriage to transport people over the highways rather than an interesting piece of mechanism.

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I believe that within a season or two a practical design for folding the top into the body will appear; the top being entirely out of sight when down. The design should be so worked out that there will be no necessity for removing any straps or slip cover. It should also permit of the top being much more quickly brought into place; with the present arrangements it takes several minutes to uncover and unstrap the top.

While not strictly connected with body design, there is a very marked tendency abroad to increase the height of the hood, due undoubtedly to the use of long-stroke engines. The hoods have a circular-shaped top, getting away from the old Mercedes type; being also much wider at the rear, making it very easy to design a streamline body merging very gradually and in some cases imperceptibly into the hood. The new radiators are also rounded off so that all angularity is obliterated. The top edges of the body, instead of being straight and finished with a bead, are rounded over, the upholstering coming flush with the top edge and not being overstuffed. This makes a very pleasing appearance, very much in keeping with the streamline design. The tendency is to get rid of all angles and round all corners, giving the whole car as much of the stream line as possible. This is a logical development and will eventually be the generally accepted design. The tires, top and all other accessories will also be covered within the body. This will not be accomplished in one season but be a gradual development.

My remarks apply not only to touring cars but largely to limousines, as to which there is at present a divergence of opinion as to what is really the best type. The streamline type of body originated in Germany and was not taken up widely in France until recently. The rounded type of limousine is an outgrowth of the streamline touring body. The use of the rounded-roof type of limousine has grown considerably within the last year. It is popular over a large part of this country, but we find that New York city patrons prefer the flat or old-style roof dipping at the front toward the dashboard. This is undoubtedly due to the fact that so many French bodies are used in New York, the French designers not having adopted the German style. To take up the more specific points in limousine design, there are very few of the double-compartment type now being made. Frameless glass is used universally. There is a strong tendency to use more hard wood in the interior trimming. Very little broad lace is used in the trimming. There is a tendency to conceal the toilette cases by some makers, but this is a doubtful improvement.

There is undoubtedly a growing demand for closed cars. The public has accepted the automobile as a permanent institution and the owner of a car is not now satisfied to put his machine away for the winter but expects to use it throughout the year. Naturally the man who drives his own car is as desirous of protection as those who ride in limousines. It was for this class of owner that we developed our convertible body. Strange as it may seem, 90 per cent of our customers owned limousine cars; having been used to the comfort of closed bodies they desire the same protection when touring on cold nights or rainy days. We believe that eventually all touring cars will be supplied with some form of con-

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vertible body. The owner will then be equipped for all-the-year use of his car and can adapt it to the weather or his various moods.

To sum up, the present tendencies in body design are toward the streamline type, hood and cowl merging into the body, rear extended to enclose top and extra tires and an outline to minimize wind resistance, all edges rounded off, five-passenger bodies with two doors only, and convertible top to give complete glass protection when needed. The enlarged cowl will provide plenty of room for the gasoline tank, convex fenders and probably all lamps set in and made flush with the guards, radiators or body. The headlights will be provided with dimmers or extra bulbs of small power. The whole tendency of logical design is to smooth off the body in every way possible, removing all projections, greatly facilitating cleaning, which is really a great advantage. The owner of the future will demand a car that will be comfortable to ride in at all seasons, that can be changed from open to closed with the minimum of time and trouble and in which all accessories and spare parts will be covered and protected and easily kept clean.

Bodies will look odd to us as we experience the evolution; first, the concealment of the extra tires, then perhaps the elimination of the usual folded top, then non-projecting lamps, etc. Finally we will wonder why we formerly covered a car with so many trappings.

Presented at Detroit Section Meeting.

WOOD WHEELS ON HEAVY VEHICLES

By Clarence B. Hayes*

(Associate Member of the Society)

The rapid growth in the last few years of the manufacture and use of heavy-duty commercial vehicles has given rise to the establishment of a new branch of the wheel industry, that of the so-called truck wheel. This type of wheel stands quite apart from that designed for the pleasure car, owing to the very different conditions it is called upon to meet, the different sorts of demand made on it in service. In the one case we have comparatively light loads, driven at high speed, demanding a light, elastic member capable of quick recovery from road shock, the principal strain being due to side-thrust, the result of skidding, curb impact and similar treatment, not encountered to so great a degree by the slower-moving motor truck. In the other case, we find extremely heavy loads driven at relatively low speed, stability and durability being first considerations.

As the advent of the automobile wheel was followed by abandonment of buggy-wheel methods, as unsuited to the needs, with the coming of the truck wheel the wheel-maker was confronted with a new problem and forced to work along different lines to attain the desired result—a cor-

*President Hayes Wheel Company.

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rectly designed, well-proportioned product to be relied upon. Although still seizing every opportunity for improvement, he has already met with success, and in the present wood artillery wheel has a type peculiarly fitted to stand up under the severe usage to be expected in its work on a heavy vehicle. The cost is low as compared with steel or malleable iron wheels, while light weight and ability to absorb shock make for longer tire life than in the case of heavier, more rigid metal wheels, which throw the larger portion of the road shocks upon the axle and bearings. The theory has been advanced that the quick radiation of heat by the metal wheel means lower tire temperature with a correspondingly longer life. We are rather skeptical on this point, for the heat is generated at the point of contact of tire and road surface, and it seems likely that most of this heat is transmitted to the surrounding air rather than up through the rubber tire and steel band and thence to the wheel proper.

When the first truck wheels were built some trouble was experienced because of the wheels getting out-of-round and out-of-true, causing more or less attention to be paid to the question of metal wheels, which undoubtedly can be made without much difficulty in this direction. This trouble has now become practically a thing of the past, however, and the present-day wood wheel, made according to modern methods and by specially designed machinery, is not only true and round at the start but remains so.

There are two dominant qualities in the wood wheel that make it stand out prominently—resilient, cushioning resistance against the evil effects of American road conditions, and remarkable ability to withstand the severe climatic conditions here, with extreme temperature change. Wood is not susceptible to temperature change to any extent, the only factor entering being moisture; admittedly wood will deform if allowed to absorb moisture. By the use of bone-dry stock, the pores being filled with lead or oil primer, and several coats of paint being added, ample protection is afforded against change of shape.

Many attempts have been made to design some substitute for the wood wheel that will absorb vibration, the great enemy of longevity of a motor truck. The results to date have been unsatisfactory, most of the substitutes being costly, of prohibitive weight, and having little or no provision for taking up lateral strains, which, as a rule, either cause partial failure of some part, or leave a permanent set which becomes greater with each successive shock. The wood wheel receives the side-thrusts, yields to them gently with a minimum of shock and promptly springs back to its original position after the strain is removed.

Some time ago some tests were made for us at the University of Michigan laboratories on both pleasure car and commercial car wood wheels. A brief summary of the results in one or two typical cases may prove of interest.

Size of Wheel	*Spoke Flange*	*Type of Wheel*	*Dishing Load*	*Direct Load*
34 x 3 S	2″ x 8⅝″	1-ton front	16,100 lbs.	40,800 lbs.
36 x 4 D	3″ x 12″	3-ton rear	30,100 lbs.	114,000 lbs.
40 x 5 D	3½″ x 13¾″	5-ton rear	48,300 lbs.	140,000 lbs.

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One 36" x 4" dual wheel tested to the limit of the dishing load, and then for direct loading, stood up to 107,000 pounds, or within 94 per cent. of the maximum allowance load. A 36" x 5" dual wheel, tested the same way, stood up to 133,000 pounds, or within 95 per cent. of the maximum. With the 36" x 4" 3-ton rear dual wheel a record was made of the deflection up to 12,000 pounds, then a little more rapidly until the maximum point of 30,100 pounds was reached. Loaded at 23,000 pounds and released, the wheel regained its original position and even from the maximum or breaking point recovered to a remarkable degree, with 1/10" permanent deflection. The wheels had no initial dish, as is provided in the case of pleasure car wheels for added protection against pulling the heart out of the spider. A glance at the tests is sufficient to show that there is little question of the wood wheel being able to stand up under the heavy loading put on it in practice. Failures are very rare, and in practically every case can be traced to either the use of a wheel on a heavier car than that for which it was designed, or the use of brashy timber which under ordinary circumstances would never escape the eyes of the stock grader.

The wheel life would be lengthened materially if more attention were paid to the condition of the tires and they were replaced after having served their time. The old-style truck wheel, intended to serve without a rubber cushion, was assembled with a heavy band of steel ¾" thick. The present truck wheel, to be used with a solid rubber tire, is equipped with a relatively light band, ¼" thick on the smaller single sizes, ⅜" on the larger single and all dual sizes. When the truck owner permits his tires to become worn to a thin ribbon, unable longer to do their work, and forces the wheels to stand treatment for which they were never intended, he is simply throwing away so many years of good wheel-life unnecessarily.

For years the wheel-maker followed individual designs submitted by customers, in a good many cases against his better judgment, but in the past year or so there has been a growing tendency to defer to the opinion of the wheelwright, to leave the design, in part at least, to the man whose experience cannot but prove a valuable asset to the car builder.

The time may come when the wood wheel will be replaced on heavy vehicles by some other type; by some substitute which will either fulfill the required conditions *better* at the *same cost*, or *equally well* at a *lower cost*. For the present, at least, there seems to be a lack of such a substitute.

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Presented at
Detroit Section Meeting.

SELECTING BALL AND ROLLER BEARING SIZES

By D. F. Graham.*

A good deal has been written about the figuring of the size of and getting a bearing that will do the work, but, after all, the best thing that we have to go by today is the experience we have had in the last six or eight or possibly ten years. You can figure all you please about the sizes; perhaps it helps to a certain extent, but the best answer is, does the bearing do the work?

The metric-sized bearings were carefully worked out by the foreign engineers years before we had anything to do with them. In other words, before we began to build bearings, the sizes were determined. Just why they were determined as they were, I do not know. As you all perhaps know, they vary by five millimetres in bore, that is, from one size to the next.

Another thing that probably all do not know and is oftentimes a help in getting in mind the size of a certain number, is this: In an annular or metric bearing, multiplying the last figure by five gives the bore in millimetres; for instance, the 307 has 35 millimetres bore; the 207, 35 millimetres; the 407, 35 millimetres; the 8, 40; the 9, 45; the 10, 50, and so on. That is true down as far as the 4 size; below that bores do not vary by the same law.

The safest guide in selecting a bearing size is the shaft. Of course, to put a bearing on a shaft the bearing must have the same bore as the diameter of the shaft. If the load is light, use the 200 series; if the load is medium, the 300 series; and if the load is all that the shaft will carry, the 400. That, roughly speaking, is the basis of the annular-sized bearings.

With the roller bearing the problem is entirely different. In our own experience we have found that it is not necessary to make the 400 series at all; the 300 series will carry all that a spindle or shaft will carry. About the only question an engineer need ask is, what is the weight of the car, and what material is the spindle to be made of? After those questions have been determined, he can very easily determine the diameter of the spindle. The only remaining question is fitting the bearing to the shaft.

We sometimes have the question: What bearing is recommended for a front wheel of a car weighing 2100 or 2500 or 3000 or 3500 lb., or whatever the weight may be? Many questions enter into that. First of all, the material to be used in the spindles; low or high carbon steel, heat treated or not, etc. After determining that you can easily calculate the size of the spindle.

*Sales Manager and Engineer, Bower Roller Bearing Company.

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Next comes in the weight of the car; the proportion of the weight on the front axle. Then comes the turning radius of the car, the power and speed of the motor, and the wheelbase. All that has to do with the strain on the bearing in turning corners or in fast driving. I think you can readily see that it all figures down to the fact that the spindle size is the thing that governs very largely in determining the size of bearing for a certain position.

THE METRIC SYSTEM

The question often comes up as to why we use the metric measure at all in bearings. It does not work in very well with our sizes here, especially of shafts, which, as a rule, are made in inches or fractions thereof; you must either buy a shaft that is a little large and grind it down, or compromise in some way. The answer to this is that it is impossible to change the sizes of the foreign bearings. The percentage of foreign bearings used in this country is so large as to control to a large extent the sizes of bearing used. The bearings manufacturer must make the sizes that will interchange with the other makes of bearings, and if he made them to inches, they would not interchange with the foreign bearings at all. Moreover, the foreign bearings advance by five millimetres, which gives a wide range of sizes. I have found very few cases where an engineer could not use a metric size practically as easily as an inch size. In addition, the metric size has the advantage of not tying him up to one make of bearing; he has the selection of anything that comes from Europe or is made in this country; whereas, if he goes to inch sizes he is tied up to only three or four makes of bearing. We have, of course, the Hyatt, which is in inches. The Timken bearing is largely in inches. The Bower company also make the inch sizes. Those are about all you can choose from in inch sizes. As there is not a single annular ball bearing made in inch sizes, either in this country or abroad, it seems that it would be a very good thing if we could get the engineers to agree to use the metric sizes of bearing exclusively. In the case of our own factory, this would cut down the number of sizes we have to carry, or at least the tools we carry, very nearly one-half, which would, of course, reduce the cost of manufacture. I think you will all agree that it is impossible to compel foreign manufacturers to change their sizes. So many millions of bearings made in metric sizes are in use that we have to make metric sizes anyway for repairs.

In regard to the carrying-capacity of the roller bearing as compared with the ball bearing, I believe none of us knows just what that is. The basis of the calculations for the load-carrying-capacity of bearings is unquestionably Professor Stribeck's experiments. He has made a more systematic study of the load-carrying-capacity of metals under rolling contact than anyone else. From his experiments it was found that the load on a ball, in other words, the indentation of the ball in the race, varied almost exactly as the square of the load. In any ball bearing if the load on a ball is carried to a point where the indentation is beyond the elastic limit of the surfaces of the ball and the race, the bearing is at once permanently impaired, and it is only a question of time until it will become destroyed. Compare with that the load requisite to carry on a

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roller in order to deflect the surfaces beyond their elastic limit, and you see how much greater the load-carrying-capacity of the roller should be than that of a ball. But there also enters into that the question of the friction of the surface; although there is supposed to be a true rolling surface, there is undoubtedly a friction. If there were not, roller or ball bearings would not need any lubrication. Just how far that question enters, I believe none of us knows exactly. In all bearing manufacture the principal matters unquestionably are good material and accurate workmanship.

When you take into account that in any ball or roller bearing you have anywhere from twelve balls or rollers and the inner and the outer races, making many pieces in each bearing which must be held within two ten-thousandths variation, you can see what it means to make a bearing; how the slightest error in hardening, grinding or inspection of any one of the parts will cause a bearing to not stand up to the work as it should. The surprising thing is not that the bearings fail occasionally, but that more of them do not fail.

My experience is that about the best guide for the selection of sizes of bearings is good horse-sense, combined with experience in building cars. I have seen cases where bearings of seemingly ample size were destroyed; and again little bearings that you would think would not stand up under the load at all, answered the purpose admirably. I remember the Matheson car in the Wilkesbarre hill-climb. In the first little-six of that make there was a propeller-shaft of less than one inch diameter, of very fine steel. A 305 bearing was used back of the pinion on the rear axle. The car won the hill-climb mentioned and was driven all season with the 305 bearing, which never failed. I could not explain that.

I have seen a 400-series bearing fail in that same place. In an experience we had at the Weston-Mott factory while I was with the New Departure company, we had some trouble with the bearings back of the pinion on the rear axle with a long torque tube. The motor used was of fairly good size. We finally found that the shaft was springing when the load was put on it. In order to satisfy ourselves just how much it was springing, we made four holes at the center of the torque tube, and put four Brown & Sharpe dial-indicators through it so that they were just touching the shaft when turning idle. A deflection of two or three thousandths was indicated, as little as you would expect in a shaft of the length in question. As soon as a material amount of power was transmitted through the shaft, it deflected almost one-eighth of an inch in a transverse direction, causing a prying action across the bearing, just as if a lever had been stuck in it. It was no wonder the bearing did not stand up. Later a bearing was placed at the center of the tube to hold the shaft from springing.

I have known of spindles that would spring to such an extent as to throw an extra strain on the bearing. Such things must be taken into account.

It is almost impossible for the engineer to figure them out on the draw-

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ing board or by calculation. It is almost impossible to figure out just what strain comes on a front wheel in turning a corner. You do not know whether there is going to be a hole in the road, or at what speed it will be hit, the angle of turning, or anything about it. There are so many unknown quantities in the problem that I believe no engineer can calculate all of them accurately.

CONTRIBUTED BY B. D. GRAY

In most cases it has been found that in a ball bearing of the 400 series, in which the workmanship and materials are first-class, its capacity exceeds the safe carrying-capacity of the shaft which the bearing in question will accommodate.

With relation to the relative carrying-capacities of ball and roller bearings, I believe there is a point of design to which comparatively little attention has been paid in discussions of this nature, and which is decidedly important—that is, the concavity of the path of the ball. We know that the carrying-capacity of a ball is very greatly affected by the shape of its support. In the usual ball test three balls are placed together one on top of the other, the end balls being supported in cup-shaped pieces, and the middle ball held in its position merely by pressure. Naturally the convexity of the surfaces in contact produces tremendously high unit pressures when a given load is applied. If the ball to be tested is placed between flat surfaces, the unit pressure is considerably less, and if the supporting surfaces are curved to a radius only slightly larger than that of the ball, the crushing strength of the ball is still further very greatly increased. In the annular ball bearing the path of the ball, which is commonly referred to as the "groove," is ground to a radius only very slightly larger than that of the ball, and while that is in only one plane, that is, parallel to the shaft axis (since the groove is circular, in a plane at right angles to the shaft axis), yet this feature has a very decided influence upon the capacity of a ball bearing, and it should be borne in mind that a similar shaping of the rings, commonly called "cups and cones," is not possible in a roller bearing. The surfaces with which the rolls come in contact must be either cylindrical or conical. Since, when a load is imposed upon a ball bearing, the much-talked of "point" contact is converted by reason of deformation of the surfaces carrying the load, into a substantial "area," it will be understood that the designer of a ball bearing has something tangible to work with, and it is not at all miraculous that the ball bearing successfully carries tremendous loads.

When we take into consideration also that the "line" contact claimed by manufacturers of roller bearings exists only under ideal conditions, namely: First, when the ring and roller surfaces are perfect, throughout the entire length of roll and width of ring, and, second, when the roller maintains its theoretically correct position between the rings, it is possible to conceive that the area of contact in a roller bearing may be, and in fact is likely to be during a great percentage of the time, less than

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that of the ball bearing, since in the latter the rolling element cannot be in any other than its correct position.

There are numerous points to be considered in a discussion of the merits of any anti-friction bearing, such as uniformity of product, stiffness of rings, etc., in addition to materials and workmanship mentioned by Mr. Graham, and, furthermore, no amount of talking, pro and con, can change the facts. "The proof of the pudding is in the eating." The best way to decide is by actual test, since this process of elimination dispels all doubt in the mind of the seeker after information.

CORRECTED ADDRESSES OF MEMBERS

Edwards, F. E., formerly owner, F. E. Edwards Automobile School, Chicago, Ill., now Consul (Chicago, Ill.) the Lincoln Highway Association, Inc., Detroit, Mich.

Jehle, Ferdinand, formerly engineer, Commercial Engineering Laboratories, Detroit, Mich., now laboratory engineer, Automobile Club of America, New York City.

Jencick, Stephen, formerly president, Jencick Motor Corp., Portchester, N. Y., now designing engineer, Nott Fire Engine Co., Minneapolis, Minn.

Jones, E. L., formerly vice-president and general manager, Jones Electric Starter Co., Chicago, Ill., now with Enger Motor Car Co., Cincinnati, Ohio.

Kurti, A., formerly with Irwin D. Groak Engineering Co., Chicago, Ill., now with W. T. McCaskey & Co., Chicago, Ill.

Mergi, Wm. H. P., now connected with Denby Motor Truck Co., Detroit, Mich.

Randall, R. H., formerly chief engineer, Ultra Motor Car Co., Boston, Mass., now with Wollaston Foundry Co., Norfolk Downs, Mass.

Steele, John Wm., formerly chief engineer, Mitchell Lewis Motor Car Co., Racine, Wis., now with Kelly-Springfield Motor Truck Co., Springfield, Ohio.

Waite, J. D., formerly factory manager, Stromberg Motor Devices Co., Chicago, Ill., now with Stamping & Tool Co., LaCrosse, Wis.

Wilcox, H. A., formerly with Federal Motor Truck Co., Detroit, Mich., now with Signal Motor Truck Co., Detroit, Mich.

Wilson, Charles B., formerly vice-president, Ferro Machine & Foundry Co., Cleveland, Ohio, now president, Wilson Foundry & Machine Co., Pontiac, Mich.

Woods, S. H., formerly designer, General Vehicle Co., Long Island City, N. Y., now inspector, Compensation Inspection Rating Board, New York City.

Youngren, H. T., formerly engineer railway division, Westinghouse Elec. & Mfg. Co., East Pittsburg, Pa., now with Harley-Davidson Motor Co., Milwaukee, Wis.

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POSITIONS AVAILABLE

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55. Tool draftsmen. Men experienced on motor design.

123. Production manager or production superintendent. Man who can reduce costs and get out quantities.

127. Salesman for heavy trucks on a commission basis. Not necessary to give entire time.

*135. Sales manager, salary and commission to be agreed upon.

142. Young man familiar with machine design. Experience on presses and shears preferred. Salary dependent on experience.

*147 Sales manager, experienced, on commercial work, and in a position to invest $2,000. Exceptional opportunity.

*151. Salesman to handle special steels in New England. Must be technically trained and have had practical experience in machining and heat treating of steels.

*158. Draftsmen, with experience in designing small motors or generators for automobiles. For factory manufacturing small interchangeable parts for electrical apparatus. Only those having had at least three to four years' experience need apply. Salary $18 to $22.

159. Designer of successful special machine tools for multiple coincident operations, to design various machines for rapid production of small vehicle parts. Should have factory production experience.

*161. Manager for service, parts division and garage of large corporation. Must have excellent engineering and executive ability, besides broad experience in this particular line of work.

*167. Salesman, one that is capable of managing sales department, familiar with the automobile trade and of pleasing personality.

168. Salesmen for electrically-driven tire-pumps for private garage use, on a commission basis.

169. A high-grade retail salesman of moderate-priced pleasure cars for New York City proper.

172. Tool draftsman. State experience and salary desired.

173. Assistant engineer; must have some shop and at least two years' motor testing and operating experience. Moderate salary, which will be increased as circumstances and conditions might warrant

174. Engineer or experienced man capable of designing attachment parts for shock absorber.

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*Send written application to S. A. E. office to be forwarded to employer.

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176. Inspector on automobile parts. Must be A1 man.

178 Draftsman.

*179. Expert final chassis tester and motor expert, on commercial work.

181. Technical graduate of two or three years' experience, preferably in production end of automobile manufacture, for office work in sales and order department of parts manufacturer; leading to sales engineer.

184. Experienced automobile draftsman—resident of New York City preferred.

*185. Wanted by one of the largest automobile accessory manufacturers, a first-class man on die castings (especially die-cast aluminum) to organize a separate department. This is an opportunity for a man who is no has-been or experimenter. Give full particulars in first letter or no notice taken.

186. Assistant mechanical engineer for automobile factory in the middle West. Prefer technical school graduate but must have had a number of years' practical experience, preferably with the larger automobile manufacturers.

*187. Experienced superintendent of repair department of large garage. Young man with technical education preferred. Excellent opening for capable man. Applications from men without considerable experience in automobile repair work not considered. State minimum salary expected and qualifying experience.

188. Assistant in purchasing department.

189. Foundry foreman; one who can handle men and knows foundry business, especially in the cast-iron line.

190. Experienced production man for a light four-cylinder car.

191. Mechanical designers with experience on ignition, electric starters, etc. State age, education, experience in detail, whether married and salary expected.

*192. First-rate man with general engineering experience to take charge of drafting room. Must understand motors of the motor car type and be a good executive.

193. Employers' agency seeks tool designing draftsmen. Openings in middle West. Salary 40c. to 60c. per hour, depending on ability and experience.

*194. A well educated man for a position on the editorial staff of a leading motor vehicle trade journal. Must be a clear thinker, a good, easy writer with a keen appreciation of journalistic values. Must have a knowledge of finance, industry, transportation and economics. Engineering talent or at least an acquaintance with motor vehicle design and construction, is essential. Must be willing to work under a prearranged editorial policy, able to produce high quality copy on scheduled time, and must know printand engraving.

*Send written application to S. A. E. office to be forwarded to employer.

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MEN AVAILABLE

0234. Mechanical engineer, twelve years' experience with some of the best automobile companies of the country wishes position as sales engineer in progressive concern making some kind of mechanical specialty.

0255. Service engineer, carburetion especially. Twelve years' experience in motor car troubles. Would like position as assistant manager of service department, taking the practical detail work.

0257. Draftsman and designer, experienced in design of motor trucks, adding machines, with broad technical education supplemented with shop work, desires a position as designer and engineer in charge of drafting room or engineering department. Have practical experience, able to work out mechanical design. Eight years' experience in automobile and adding machines. Can handle men.

0258. Engineer, capable, energetic, ten years' experience on pleasure, commercial car and electric starter work, desires position as mechanical engineer or chief draftsman. Would like to connect with small live company in which later a financial interest might be taken. Have specialized on efficient running of drafting room, and would consider temporary engagement for systematizing work.

0259. Motor and chassis designer and checker. Technical graduate with shop experience; specialist on design for quantity production. Have had several months' shop experience with firm building stationary engines, jobbing shop, and with a general manufacturer.

0260. Engineer and producer; ten years' automobile experience as designer, chief engineer and factory manager. Mechanical engineer graduate, thirty-two years old, able and reliable; last position, engineer and factory manager of large plant; connections severed when plant was changed from automobile manufacturing to making of one unit only. Best reference.

0261. Engineer with thirteen years' experience in design and construction of automobiles, trucks; automobile, stationary and marine two-cycle and four-cycle engines for both gasoline and kerosene. Ten years with present employers in large factory. Open for position soon. Manager or engineer in suitable situation desired. Age, 39 years.

0262. Mechanical engineer, eight years' experience in engineering work on light trucks and small cars. Exceptionally good practical experience. Good correspondent and familiar with costs. Capable of handling responsible position. Prefer connection with concern manufacturing product or with parts manufacturer. Have an interesting cyclecar design for any one favoring the new field. Have held present position as chief engineer for past three years.

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0263. Designing engineer with broad experience on designing and manufacture of pleasure cars with well-known concerns. Employed at present. Best references.

0264. Factory manager, good organizer and producer with wide experience in engineering and production of both pleasure and commercial cars.

0265. Engineer with eleven years' experience in design and construction of high-class American cars. Specialist in development of high-speed efficiency motors. Authority on carburetion.

0266. Young man experienced as purchasing agent, desires to secure a position with a future.

0268. Mechanical and electrical engineer, now employed, experienced in designing, engineering, superintending constructions and productions in quantity, sheet metal specialties and electric vehicles; also gasoline cars. Open for position in New York City or immediate vicinity.

0269. Body or executive engineer for chassis department in or near Detroit. Have been "producing" for ten years and am at present with one of the largest and best known manufacturers of automobiles in the world.

0270. Engineer and factory manager, of wide mechanical experience; last nine months on light cars; thorough mechanic.

0271. Position desired as superintendent or chief inspector. Have had charge of men for fifteen years. Experience covers several years' designing gasoline motors, on transmission and gears, in charge of inspection with well-known automobile company building a high-grade car. At present employed as chief inspector with one of the largest automobile companies making sheet metal stampings using small and large dies.

0272. Engineer and purchasing agent, with eight years' experience in light pleasure car and all capacities of commercial car designing, is open for engagement. Can furnish first-class references.

0273. Young man of 25, with four years' experience on the editorial staffs of automobile trade papers is at the disposal of an advertising manager. Would be glad to submit advertisements that he wrote while doing editorial work. Not a "know-it-all" and is willing to start for a fair living salary.

0274. Graduate mechanical engineer with fifteen years' experience in engineering and production departments of motor vehicles and accessory manufacturers, available for position soon; now engaged.

0275. Man with seven years' drafting experience on pleasure cars and electric starter work wishes to take charge or assist in establishing a drafting room system which turns out excellent drawing in minimum time.

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0276. Service manager or engineer with excellent executive and engineering ability. Experienced in truck and pleasure car manufacture, design, repair and shop practice. Wide mechanical experience. Used to handling men and assuming responsibility. Good correspondent. Married. Age thirty-four. Western location preferred.

0277. Engineer, mechanical and electrical. Capable and energetic, with excellent executive ability. Exceptionally good practical experience on both trucks and pleasure cars in engineering, designing, purchasing, shop practice, construction and production. Especially competent on electric systems. Able to handle men and fully capable of assuming responsibility. Married. Age thirty-three. Salary moderate.

0279. Pioneer automobile engineer and executive who has a very wide and accurate knowledge of pleasure car and truck engineering and business conditions in this country and abroad, would consider engagement on a basis commensurate with his previous work and success. Development work in the East preferred.

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(Address) 109 Webb Avenue, Detroit, Mich.

Meets first Thursday each month at 8 p. m., in the Employers' Association Rooms, Stevens Building, Detroit, Mich.

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Meets last Thursday each month, except July and August, 8 p. m., at the Automobile Club of America, 247 West Fifty-fourth Street, New York City.

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Please change my address now appearing on your records, to the following:

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Very truly yours,

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S. A. E. BULLETIN

Vol. VI September, 1914 No. 6

Engineering Library OCT 2-

WORK OF THE DIVISIONS

MOTOR TESTING FORMS

STANDARD FELLOE BANDS FOR PNEUMATIC TIRES

AUTOGENOUS WELDING

TREND IN MOTOR DESIGN

EFFECT OF RACING ON MANUFACTURE

SOCIETY OF
AUTOMOBILE ENGINEERS

1790 Broadway, New York

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S. A. E. Bulletin

VOL. VI SEPTEMBER, 1914 No. 6

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HENRY M. LELAND, President. COKER F. CLARKSON, Secretary.
HERMANN F. CUNTZ, Treasurer.

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WINTER MEETING

The 1915 Annual Meeting of the Society will be held in New York early in January during the time of the Automobile Show.

WORK OF THE DIVISIONS

Several of the Divisions of the Standards Committee are now resuming active work as indicated in the brief account given hereinbelow. The next convention of the Standards Committee will be held during November, the sessions of the meeting probably extending over three days, upon which reports of Divisions will be submitted and considered. Meetings of the Divisions having work actively in hand will be held during the Standards Committee convention and in some cases prior thereto.

STOCK SIZES OF ROLLER BEARINGS

The Ball and Roller Bearings Division still has under consideration the matter of recommending a list of stock sizes of roller bearings, eliminating many of the sizes now listed by manufacturers.

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SIDE-OUTLET CARBURETERS

The Carbureter Fittings Division is making a close study with a view to determining whether it is feasible or advisable to recommend standards in addition to the present S. A. E. standard carbureter flange dimensions, to cover the application of side-outlet carbureters. It is thought by some that it would be wise to recommend as standard, or at least as recommended practice, the positioning of the side-outlet carbureter flange with the bolts spaced on a horizontal center line. It would be of considerable advantage to manufacturers and users if a standard could be established in regard to both the shape and position of the flange on side-outlet carbureters. It is felt by some, however, that the development of motor design will be accompanied by reasons for the adoption of either a horizontal or vertical flange that will be of sufficiently great weight to render necessary ignoring any standard that might be adopted as to the face of the flange on the cylinders being horizontal or vertical. The design of the carbureter for the particular motor upon which it is going to be used must, of course, be considered. It is believed by some of the members of the Carbureter Fittings Division that there will always be both vertical and horizontal type carbureters, but that where the horizontal type is used bolted directly to the cylinders it seems that it would be advisable to standardize the position of the flange, the drilling of the cylinders first one way and then another causing considerable trouble. Where the vertical type is used it is always necessary to supply a separate intake pipe in which case the flanges can be made either one way or the other. Cylinders constituting a large unit, it is naturally beneficial to maintain the machine work on them the same, although different equipments are used. There has become apparent no good reason for deviating from the standards which have already been adopted as to the dimensions of the attaching flange.

The problem in question is radically different from anything the Carbureter Fittings Division has so far attempted in the way of standardization and the development of the subject is watched with interest.

THICKNESS OF S. A. E. FELLOE BANDS

The statement has been made that the thickness of the S. A. E. permanent metal felloe band for truck wheels is not sufficient in the case of some sizes of wheel. At the time this standard was formulated some years ago, the subject in point was considered very carefully and the Commercial Car Wheels Division, which made the recommendation originally, has seen no adequate reason for recommending a change in the standard, but will, it is expected, give serious consideration to the complaints that have been received in the connection.

It is appreciated that the band should be no thicker than is necessary to protect the wheel sufficiently, so that no surplus weight shall be added on account of the band. It is evident from the variety of sizes of spokes

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in the wheels and the diameter of the hub flanges used by different manufacturers of trucks, that there is a great variety of views and specifications. It is, therefore, obvious that there will be a variation in the general strength of wheels as used in service. It is pretty clear that in the promulgation of the S. A. E. standard felloe band thickness, the purpose was not to have any of the fundamental structural strength of the wheel depend upon the felloe band. It is contended at this time, however, that practical experience has demonstrated that the felloe band does play an important part in the developed wheel strength.

In response to the very few complaints that have been received, the makers of wood wheels for trucks have been asked to present their views on the particular point in question, and will probably attend the meeting at which the subject will be taken up by the Commercial Car Wheels Division.

INDUSTRIAL MOTOR TRUCK STANDARDS

In addition to the work already in hand, the Truck Standards Division and the Electric Vehicle Division will consider the recommendation of standards with regard to industrial motor trucks. At the last meeting of the Council it was voted that two advisory committees be appointed, one to act with the Truck Standards Division and one with the Electric Vehicle Division for the purpose of recommending standards for industrial truck practice; the first named advisory committee to take up specifically capacity and speed of the said trucks and tires for the same, and to be constituted as follows: T. V. Buckwalter, C. E. F. Ahlm, J. E. Hale, A. H. Gfrorer, H. G. McComb. The second of the said advisory committees to take up motors and voltage and to be constituted as follows: R. A. Bachman and R. J. Nightingale.

The purpose of the Society is to take every reasonable precaution to have the views of experienced designers, producers and users of industrial motor trucks considered by its committees.

A committee of the Association of Railway Electrical Engineers appointed to recommend standards for industrial trucks has held two meetings, a copy of the minutes of which has kindly been furnished the Society for the consideration of its committees.

DATA ON STEEL

In addition to the work of collating returns received from various sources as to physical properties of S. A. E. steels, the Iron and Steel Division has under consideration modification and extension of steel castings specifications. It will also probably, in its next report, bring up to date the notes and instructions with regard to the steel specifications accepted at the last meeting of the Society, the last notes and instructions as to heat treatments, etc., having been submitted to and accepted by the Society at the 1913 summer meeting.

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LOCK WASHER STANDARDS

The merit of the criticism of the lock washer standards made at the last meeting of the Society has undergone some investigation by the Lock Washers Division. A report from the Division is expected on the question of whether the smaller sizes of the S. A. E. standard light series are too light. One manufacturer of lock washers has stated that ninety per cent. of the S. A. E. standard lock washers sold by it are of the light type and found very satisfactory by the automobile and parts manufacturers. It is stated furthermore that the allegation of the very small sizes spreading can be traced to improper heat treatment and that no change in the standard would be justifiable.

MISCELLANEOUS DIVISION

PITCH OF THREAD ABOVE 1½" DIAMETER

In view of the fact that the extensive data received by the Miscellaneous Division from car manufacturers as to pitch of thread in screws of greater diameter than 1½" are very confusing, additional data are being collected from parts and screw manufacturers with a view to arriving at an accepted standard, which it is believed will be possible.

SPEEDOMETER DRIVE-SHAFT ENDS

The Miscellaneous Division will endeavor to be instrumental in establishing a standard of speedometer drive-shaft ends at an early date.

LICENSE PADS

Following up the idea of bringing about some uniformity in the fundamental elements of the license pads of cars used in the various States, the Miscellaneous Division has been furnished by the authorities of practically all of the States of the Union data as to the elements of license pads that govern the size and location of attaching devices. The location of the pads is probably of first importance, the width being of second importance, since it is found that the length is dependent on the number of digits in the license pad. Thirteen States require pads 6" wide, all but one of them specifying a metal background; ten States require a width of 5½", four a width of 5", four a width of 4½", one 6½" and one 7¼". If it were possible to harmonize the statutory provisions of the various States to some average width and universal location, the car makers would be relieved of some difficulty and the States assured that license pads would be correctly and clearly displayed.

It is very gratifying to report that the authorities in many of the States have sent advices to the Society offices that they would welcome the bringing about of the much needed uniformity of practice which has been indicated.

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PNEUMATIC TIRE SIZES

Although a report of the Pleasure Car Wheels Division was accepted at the last meeting of the Society covering pneumatic tire sizes for regular equipment, inasmuch as the Division report was vague in the respect that it stated one or two other regular tire sizes were under consideration for recommendation, and it was not developed in the discussion just what oversizes would be carried in stock by tire manufacturers in addition to the regular sizes specified in the report, it has been considered inadvisable to issue at this time for distribution among the members a data sheet giving the substance of the report in the connection stated. One important consideration is that the 36″ x 5″ tire was not specified by the Division. It is expected that the Clincher Automobile Tire Manufacturers' Association will at an early date act upon the matter of establishing a new rim size for the 36″ x 5″ tire. It is hoped that at the time of the making of the next report of the Pleasure Car Wheels Division a table of pneumatic tire sizes for regular equipment can be decided upon finally, together with a specific statement as to what oversizes of tires would be available and in use in addition to the regular sizes to be specified in the table.

INFLATION PRESSURES AND PERMISSIBLE LOADS FOR PNEUMATIC TIRES

There appeared recently in some automobile periodicals tables of inflation pressures and permissible loads for pneumatic tires stated to be advocated by the various tire manufacturing companies. The Society has corresponded with the tire manufacturers with a view to securing confirmation of the said tables and establishing uniform tables based upon expert judgment of performance of tires operated under given conditions.

In many cases the tire manufacturers have confirmed the figures in the published tables. The rough rule as to inflation pressures is, of course, generally known (twenty pounds to the inch in cross-section). It appears that it would not be a very difficult matter to have inflation pressures and permissible load tables agreed upon and the Pleasure Car Wheels Division will probably attempt to have this done.

One tire manufacturing company has developed a caliper for the purpose of measuring tire deflection externally instead of measuring internal pressure with an air gage. The proposed use is to caliper the top and bottom of the tire, it being stated that if the readings are the same it is inflated properly for the load it is carrying; and if the scale reading on the top is more than the same on the bottom, the tire is over-inflated; and if the scale reading on the top is less than the same on the bottom, the tire is under-inflated.

TAP DRILL SIZES

The Research Division is making progress in the investigation involved in the matter of the determination of proper tap drill sizes.

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FORMULA FOR ROAD DESTRUCTIVE EFFECT OF VEHICLES

The Division is also proceeding with a view to recommending a formula representing the destructive effect of motor-driven and horse-drawn vehicles on roads. This subject was introduced in a paper by two members of the Society at its last meeting, at which time a vote was passed that consideration of the subject be continued in committee. A world-wide interest is being taken in road destruction which is indissolubly connected with the subject of motor vehicle taxation. The Society will, of course, consider the matter solely from a scientific viewpoint, endeavoring through its committees to arrive at the proper engineering factor. Members are requested to transmit to the office of the Society for the consideration of the Research Division their views as to how progress can best be made in the manner mentioned.

STANDARDS EXCHANGE DIVISION

The first meeting of the Standards Exchange Division was held this month, all the members thereof being present. A vote was passed that advices be transmitted to the Standards Committee of the Automobile Engine Manuafcturers' Association of the recommended practices accepted at the last meeting of the Society, insofar as such practices apply to engine design; this action being in accordance with the purpose for which the Standards Exchange Division was created, namely, co-operation in standardization work with the above-mentioned association.

BELL HOUSINGS

Consideration was given to the matter of bell housings standardization. After thorough discussion of the situation as it now exists and of the possibilities of standardization, three members of the Division were appointed a sub-committee to consider the whole subject and report back to the Division as follows: W. A. Frederick, Chairman; W. R. Strickland and W. F. Herst.

It was believed that it will be for the best interest of all concerned to arrive at some uniformity of practice for future designs in view of the present difficulties which confront engine manufacturers, transmission manufacturers and car builders, as a consequence of the present diversity in designs, it being inevitable that the more models are multiplied the greater the complexity will become. It is the view of the Division, after investigation of a large number of models, that five sizes of bell housings can probably be concentrated upon as shown by blue prints which have been furnished a large number of motor, transmission and car manufacturers for criticism.

MOTOR SUPPORTS

A sub-committee to take up with the Automobile Engine Manufacturers' Association the matter of arriving at accepted practice as to motor

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supports was appointed as follows: A. F. Knobloch, Chairman, C. B. Rose, W. A. Frederick. It seemed possible to arrive at some standard practice with regard to engine support arms, in order that the method of suspension in frames may be somewhat more uniform if not universally interchangeable. Data are being collected as to the dimensions involved in various models. That is, reach of supporting arm, position of crank shaft below supporting arm offset and location of rear face of the bell housing with respect to the center line of supporting arm in plane.

The above-mentioned sub-committees are charged with consideration of flywheel diameters, tailshaft details, etc., and all other matters connected with the interchangeability of units where engines and transmissions are involved.

SEAMLESS STEEL TUBES DIVISION

At the last meeting of the Council it was decided to discontinue the Seamless Steel Tubes Division, Chairman H. W. Alden of the Division having recommended that this be done and the same having been approved by Chairman Souther of the Standards Committee, the work of the Division having been finished for the present. A vote of thanks was passed to the Chairman and members of the Division for their work.

SECTION ACTIVITIES

DETROIT SECTION

The September meeting of the Detroit Section consisted of a musicale and informal addresses. Chairman E. T. Birdsall made some remarks introductory of the season's activities. Mr. A. R. Pardington, Vice-president and Secretary of the Lincoln Highway Association, had as a subject the engineering value of the Lincoln Highway. Mr. J. F. Barr, Secretary and Treasurer of the Gear Grinding Machine Company, gave an informal talk on gear grinding. Mr. F. W. Chamberlain, Michigan, Manager of the Library Bureau, addressed the meeting on methods of indexing engineering data.

The Detroit Section has a very comprehensive program for the year. Professional sessions of importance are planned for November, March and May.

METROPOLITAN SECTION

The schedule of meetings of the Metropolitan Section is based on the work of its Research Committees, six of which have been appointed to investigate various subjects and it is hoped will be able to report

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upon the dates assigned. The proposed program is as follows:

October 29—Report of Research Committee on Electric Transmissions. David Beecroft, Chairman.

November 24—Report of Research Committee on Engine Characteristics. Robt. McA. Lloyd, Chairman.
Supplementary subject: Eight-cylinder Motors.
(Date advanced to Tuesday on account of holiday.)

December 29—Report of Research Committee on Engine Governors. A. J. Slade, Chairman.
Supplementary subject: Magneto versus Dynamo Ignition.

January 28—Report of Research Committee on Greases. H. M. Martin, Chairman.
Supplementary subject: Asphalt- vs. Paraffin-Base Lubricants.

February 25—Report of Research Committee on Kerosene Carbureters. A. B. Browne, Chairman.
Report of Research Committee on Non-Electric Continuous-Torque Transmissions. L. M. Dieterich, Chairman.

Paper Presented at Summer Meeting.

POSSIBILITY OF FORMULATING ACCEPTABLE RECOMMENDATIONS FOR ONE STANDARD FELLOE BAND FOR WHEELS TO BE EQUIPPED WITH PNEUMATIC TIRES

By C. C. Carlton*

(Affiliate Member Representative)

The Pleasure Car Wheels Division of the Standards Committee of the Society was created to study various types of pleasure car wheels with particular attention to diameters, to various types of steel felloe bands and to the various methods of carrying pneumatic tires thereon. From

*Manager Rim Department Firestone Tire and Rubber Company.

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this standpoint, pleasure car wheels can be divided into three classes—namely, those equipped with one-piece regular clincher rims; second, those equipped with quick detachable rims requiring no steel felloe, and third, those equipped with a steel felloe band upon which is mounted a demountable rim.

I believe I am safe in saying that there is no part of the automobile in which there is more variation and in which at the same time there is so great a possibility of standardization as the wheel. The types of tire-carrying rims being manufactured number about fifty. The types in general use actually run over twenty. The first logical step presenting itself to the Pleasure Car Wheels Division is the possibility of a standard wood wheel dimension. With this accomplished, the next step would be toward a standard steel felloe band for use with demountable rims. A third and more complicated step would be toward the standardization of the tire-carrying rim itself. The Clincher Automobile Tire Manufacturers' Association, with a membership comprising the chief tire manufacturers of America, has standardized the inside diameter or contour of rims adapted to either straight-side or clincher tires, and has also standardized the circumference of the tire seat. But this association does not concern itself with the diameter of the felloe, or with the various contrivances for mounting the rim or attaching the tire.

ONE-PIECE REGULAR CLINCHER RIM

The most simple form of automobile wheel is that carrying a regular clincher rim. The rim is practically standardized at the present time, the only variation possible being in the thickness of the steel from which the rim is manufactured. This variation is so slight that for all practical purposes the wood wheel may be considered already standardized.

QUICK DETACHABLE RIMS

The quick detachable rim, whether for clincher or straight-side tires, varies only in the thickness of the steel itself, and in the method for detaching the tire. For all practical purposes it may be said that the wood wheel on which quick detachable rims are used, is already standardized, the only variation now being the thickness of the steel section. The only further step that can be made in the standardization of the wheel carrying a quick detachable rim is to standardize the device for detaching the tire, and there are so many greater problems presenting themselves that it seems well to forego any further action along this line, for the present, at least, especially in view of the fact that the quick detachable rim has been practically displaced by the demountable.

DEMOUNTABLE RIMS

The real problems, then, confronting the Division are those presented by the demonntable rim. The first object of the committee, I believe, should be to arrive at a standard wood wheel dimension, the accomplish-

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ment of which would surely be most welcome to all wheel manufacturers as well as automobile builders. After this is accomplished, if a standard steel felloe band can be accepted, the same as the Society has succeeded in accomplishing for truck wheels by the acceptance of the S.A.E. band, the struggle will then be past the crisis. It seems of much less importance that the demounting features be standardized or that the method of attaching the tire be made uniform. But the first complication arises from the fact that consideration of wood wheel diameters and felloe band contours involves the nature of the rim base itself, and the respective form of demounting feature. Likewise, an apparently slight change in the steel felloe band may mean an entire change of the rim base. No standardization is possible, however, without working some hardships upon the various manufacturers of the product to be standardized. Thus the standardization of the S.A.E. band forced the majority of solid tire manufacturers to discard not only their removable rim equipment, but even affected the construction of the truck tires themselves. Consequently, after the Society of Automobile Engineers has accomplished without fear or favor the standardization of the S.A.E. band, it is, indeed, well equipped to undertake the pleasure car wheel standardization which concerns a much greater number of manufacturers, but does not involve any more radical changes.

DEMOUNTABLE RIMS

Two Distinct Classes

Consideration of the adoption of a standard wood wheel dimension for all demountable rims, involves at once the type of steel felloe, which in turn is governed, first, by the device by which the tire-carrying rim is fastened, and, second, by the nature of the rim base itself. Practically all of the demountable rims in common use—in fact, considerably over 90 per cent. of those purchased by the car manufacturers to-day—can be divided into two classes:

First—The so-called local-wedge-type rim, which is seated upon a felloe band manufactured from straight bar steel, flanged up in some form at the back side, the bearing at the front being secured by a type of local wedge, which is forced flat against the steel felloe on the one side and upon which the tire-carrying rim rests on the other. This type of rim is illustrated in Fig. 1.

A type of felloe can very readily be adopted upon which all rims which present a comparatively flat surface on the under side, can be mounted. I believe no one will deny that such demountable split rims as the Baker, Detroit, Kelsey, Stanweld and Prudden, can without much difficulty be adapted to such a standard felloe band. Whether the rim is straight-side or clincher, need in no way be considered. In this type of rim the rounding edge of the under side of the rim itself rests directly upon the flange of the felloe band on one side and upon the wedges on the other.

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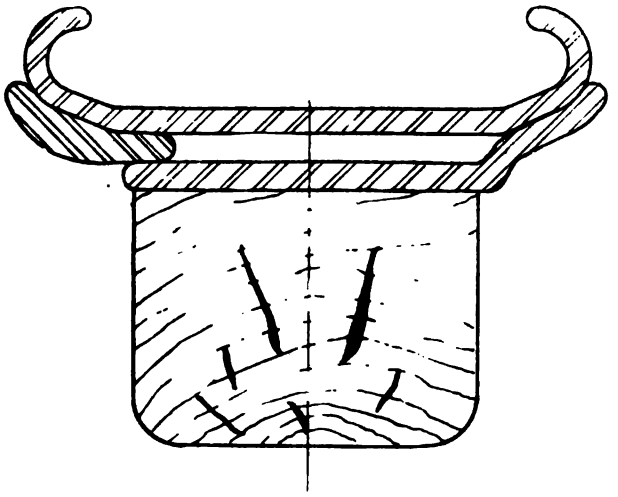

Fig. 1.

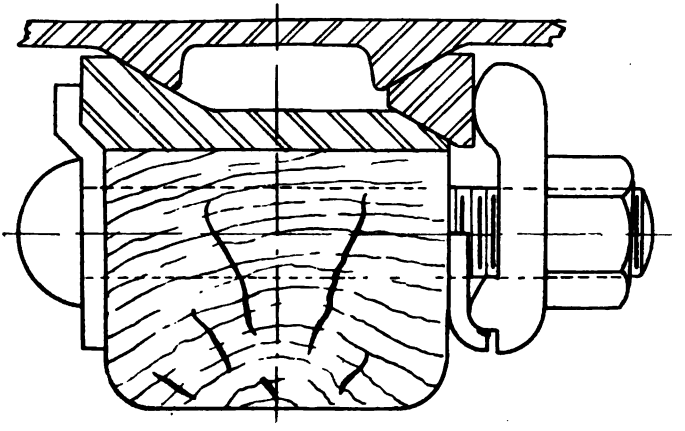

Fig. 2.

The second class of rim above mentioned is equipped with two beads on the under side of the rim base. The rims in this class are for the most part quick detachable as well as demountable. The felloe band itself must be a hot-rolled section with a flange or bevel on the back side, upon which the bead of the rim rests, as illustrated in Fig. 2. Whether this rim be for straight-side or clincher tires or universal is immaterial as far as the present discussion is concerned.

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This type of rim depends for its fastening device upon either a continuous wedging ring or upon a local wedge which has a similar bearing. This type is in use by a very great majority of American cars selling at $1,500 or above. Such rims as the Firestone, Kelsey universal, Goodyear and Standard universal are in this class.

The members of the Pleasure Car Wheels Division, who have spent much time in the study of the problem indicated, will admit, I believe, that it will be a comparatively simple matter to determine upon a set of wheel dimensions and a set of steel felloe bands, to which could be adapted with only slight changes, considerably more than 90 per cent. of all the rims of this type in common use. This would be a step forward. but to have accepted two S.A.E. standard truck felloe bands, we will all admit now, would have been a mistake. It will require much courage and deliberation on the part of the Society of Automobile Engineers to accept one steel felloe band with one wood wheel dimension as recommended practice in the mounting of pneumatic tires, but standardization which compromises is weak. After much careful consideration of the hardships that will be worked upon manufacturers the first year, I submit the following:

The Clincher Automobile Tire Manufacturers' Association has standardized the tire-seat diameter and the inside contour of the tire-carrying rim, because of the necessity of a fit as near perfect as possible for pneumatic tires upon the rim base. I believe that the standardization of a felloe band with its corresponding wood wheel diameter, which will require all rims to have a perfect seating at the back throughout the entire circumference, upon a hot-rolled felloe band section and a similar seating at the front side, is equally as important from the standpoint of tire service. The aim of the pneumatic tire manufacturers is to hold the tire as rigidly as possible in the rim; therefore, if the rim base does not have a bearing as near uniform at all times as is possible, the best of tire and wheel service cannot be secured. When the Pleasure Car Wheels Division first began its deliberation, Mr. H. S. Firestone submitted the idea of one standard felloe band and one wood wheel dimension for all demountable rims. Having in mind only the advancement of the art and the attainment of the greatest possible service of the automobile wheel as a unit, he offered the free use of mill rolls at the Carnegie Steel Co., from which proper standard felloe bands could be rolled. The Goodyear Tire and Rubber Co. made a similar offer of rolls at the Cambria Steel Co. Thus one of the first hardships of possible standardization is eliminated. Every type of demountable rim in common use can be adapted to fit this felloe band by the attaching of a bead similar to the one shown in Fig. 2 above. This felloe band insures the only mechanically perfect bearing between tire rim and felloe band. All demountable rim bases can be remodelled to fit this felloe band and the clearance between the band and the rim is sufficient to allow the use of either a continuous wedging ring or local wedges. To insure a standard wood wheel diameter calls for the adoption of but one rim dimension as standard—

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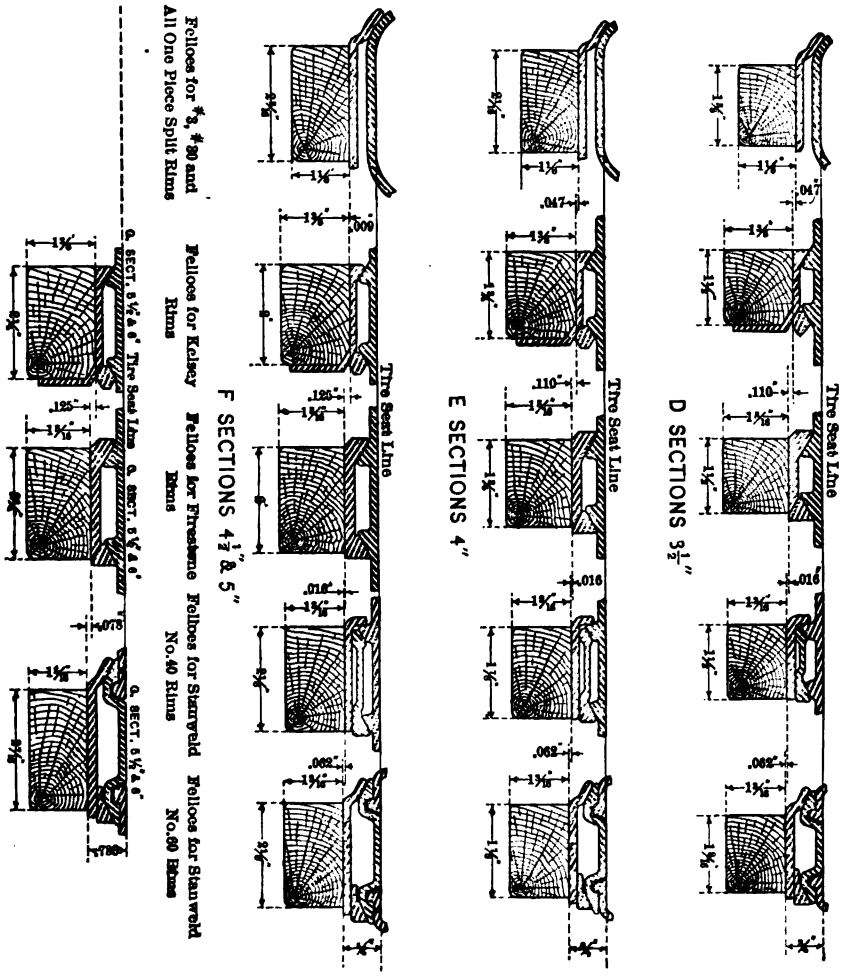
D SECTIONS 3½"
E SECTIONS 4"
F SECTIONS 4½" & 5"
Tire Seat Line
Felloes for #3, #30 and All One Piece Split Rims
Felloes for Kelsey Rims
Felloes for Firestone No.40 Rims
Felloes for Stanweld No.60 Rims
Felloes for Stanweld No.60 Rims

namely, the difference between the outside diameter of the wood felloe and the diameter of the tire seat.

It is not within the province of this paper to attempt to work out recommendations in detail, as this is a matter which can readily be solved by the Pleasure Car Wheels Division.

Summarizing, I believe it is entirely possible to standardize the section of wood felloes for the three types of rims—clincher, detachable and demountable. Further, that a standard wood wheel diameter for each size of wood wheel can and ought to be adopted, and that finally the aforesaid will make possible the adoption of one steel felloe band, upon which can be applied all types of demountable rims. Past and present

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practice make readily feasible the standardization of wood felloe dimensions and I firmly believe that the advancement of the art demands the standardization of one felloe band.

DISCUSSION

R. S. BRYANT:—I submit herewith a drawing giving the cross-section of a number of various types of rims in general use, showing the variation in the present outside diameter of the wood wheel felloes. The drawing shows very clearly some of the difficulties involved in bringing the felloes to any one standard, not taking into consideration the shape of the steel felloe band itself. You can understand readily from the drawing that the wheel-maker is not encumbered with a number of different sizes of felloe stocks. He can virtually put all the demountable wheel felloe bands upon two sizes of wood felloes, which would be necessary under practically any circumstances. All of the diameters are such that the wheel builder has only to carry two sizes of wood felloe stock to accommodate all the various types of rims.

I am very much opposed to the type of felloe band proposed in Mr. Carlton's paper. I think it is not right in theory or practice. A felloe band designed with a bevel on the outside does not support the load properly and it is practically impossible to keep the rim tight on the wheel. The load is carried entirely too much by the bolts.

MOTOR TESTING FORMS

The forms for use in connection with commercial testing of internal combustion motors, recommended by the Motor Testing Division and accepted by the Society at its last meeting, have been put into use by many of the members. Copies of the forms were distributed some time ago in the 8½ in. x 11 in. S. A. E. data sheet size. They are reproduced herewith in reduced form, together with the notes and instructions to be observed in the use of the forms.

Motor Testing Forms Nos. 1, 2 and 3 are intended to provide a means of recording in a systematic manner important data that should be noted in making *commercial* tests of motors.

RULES AND PRECAUTIONS TO BE OBSERVED IN FILLING OUT DATA SHEETS

(Numbers Refer to Lines on Data Sheets)

FORM NO. 1

(2) Piston displacement per cylinder—cubic inches $= \frac{\pi d^2 l}{4}$

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GASOLINE MOTOR TESTING FORM No. 1

Test No. ___ ___ Page_____.
Date _____

Name of Motor_____ _____

Test made in_____ Laboratory. By_____

MOTOR

*(1) No. of Cyl._____ Bore, in._____ Stroke, in._____ Cycle_____

(2) Piston Displ. per Cyl., Cu. in._____ Total per Motor, Cu. in._____

(3) Clear'ce (V_c) Cu. in._____ Total Cyl. Vol. (V) Cu. in._____ Ratio $= \frac{\text{CLEAR'CE VOL.}}{\text{TOTAL VOL.}} = \left(\frac{1}{r}\right) =$ _____

(4) Type of Cylinder Casting (Single, Pairs, Threes, Block) _____

(5) Type of Valves and Location_____

(6) Kind of Mat'l in Cyl's_____ How Cooled_____ Pump or Thermosyphon_____

(7) Piston, Weight with Rings and Pin, Lb._____ Length, In._____

(8) Rings, No._____ Type_____ Width, In._____

(9) Connecting-Rod, Weight, Lb._____ Length C. to C., In._____

(10) Piston-Pin Bearings, Mat'l_____ Dia. In._____ Length, In._____

(11) Crank Bearings Mat'l_____ Dia. In._____ Length, In._____

(12) Main Bearings, No._____ Mat'l_____ Dia. In._____ Length, In._____

(13) Inlet Valve, O. D., In._____ I. D. of Seat, In._____ Lift, In._____

(14) Exhaust Valve, O. D., In._____ I. D. of Seat, In._____ Lift, In._____
(In case of Non-Poppet Valve give dimensional sketch of port opening.)

(15) Flywheel, O. D., In.— _____ Wt., Lb._____

(16) Valve-Timing in Inches measured on circumference of flywheel.

	INLET	EXHAUST
OPENS BEFORE / AFTER TOP CENTER, In.	DEG.	DEG.
CLOSES BEFORE / AFTER LOWER CENTER, In.	DEG.	DEG.

(17) Weight of Motor, Lb._____
Indicate what accessories and how many pounds of water and oil are included in weight given

CARBURETION

(18) Carburetor, Trade Name_____ Model_____

(19) Nom. Size, In._____ Wt., Lb._____ How Heated_____

(20) General Principles of Operation_____

(21) General Description of Intake-Pipe_____

IGNITION

(22) Name and Type of System_____ Wt., Lb._____

(23) Name and Type of Distributor_____

(24) Max. Deg. Spark Adv._____ Deg. Sat'd_____ Firing Order_____

(25) Name and Type of Spark Plugs_____

(26) Location_____

LUBRICATING SYSTEM

(27) Describe_____

where d = bore in inches.
l = stroke in inches.
$\pi = 3.1416$.

To obtain total piston displacement of motor, multiply piston displacement per cylinder by number of cylinders.

(3) Clearance space: By clearance space is meant the volume occupied by the charge when the piston is at the top of the compression stroke. To

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measure this volume, place the piston on top center of compression stroke (*i.e.* with both valves closed), and fill the compression space from a graduate containing a known volume of light oil or kerosene. The filling should be done through a hole as near the top of the clearance space as possible, and care should be taken to prevent leakage. A chemist's graduate should be used for measuring the volume of oil used. This volume should be reduced to cubic inches.

The total cylinder volume = Clearance space + piston displacement (one cylinder).

(4) State whether cylinders are siamesed or each is completely surrounded by water jacket.

(5) State whether poppet, sleeve, rotary, piston or other type of valve is used; also location with respect to cylinder head.

(7) Weight of piston with rings and pin should include weight of screws or other fastening for holding wrist-pin in place or bushings for wrist-pin bearing if used. *Record all weights in pounds and decimal parts thereof.*

For length of piston give measurement of cylindrical surface parallel to axis of cylinder.

(8) Under "type" of piston rings, specify such items as concentric, eccentric, single or multiple.

(9) In giving weight of connecting-rod include weight of big-end bearing and bolts and bushing in upper end of rod, together with screw (if any) for locking same; also weight of any oil pipe or scoop normally attached to rod.

(10) Give inside diameter of bushings which form the piston-pin bearings.

(13-14) Give maximum outside diameter of valves and minimum inside diameter of opening.

(16) To determine valve-timing, mark top- and lower-center on flywheel; also the points at which each valve opens and closes (valves cold). Then measure with flexible steel scale or tape the length of arc on rim of flywheel (in inches) from centers, as indicated, to marks indicating opening and closing.

(17) In recording weight of motor include carbureter, magneto, ignition accessories mechanically attached, water and oil pumps manifolds. flywheel and all parts necessary for normal functioning of motor.

(19) Under "how heated" state whether water-jacket is used, and whether all or a portion of air is heated.

(20) Under "general principles of operation" give items such as the following:

Venturi-tube type with single adjustable nozzle and single auxiliary air-valve with one spring.

Straight-tube type, four non-adjustable nozzles coming into operation successively as air-flow increases.

Expanding type, weighted-valve controlling air and gasoline supply simultaneously.

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(21) Under "general description of intake pipe" give approximate average inside diameter and particulars, such as:

Horizontal distributing pipe about 1¼" I. D. with jacketed 6" vertical riser from carbureter and four short branches to cylinders.

Make small sketch when not easily described.

(22) Under "type of ignition" give particulars only of system actually used in test, *e.g.*,

(*Make*) high-tension magneto, single (or two) spark.

(*Make*) four-unit coil, six-volt lead battery.

Under "Weight" give weight of parts mechanically connected to motor.

(23) Under "type of distributor" give, *e.g.*, high-tension incorporated in magneto.

(24) Under spark timing give maximum degrees advance (*i.e.* degrees before center) and retard (*i.e.* degrees after center) on flywheel at which spark occurs.

(25) Under "type of spark plug" give kind of insulation (*i.e.* porcelain or mica) and number of sparking points on electrodes.

(27) Under "lubricating system" give particulars such as:

Force feed, splash, kind of pump, course taken by oil.

For example: Oil in sump forced by gear pump to main bearings under three pounds' pressure, thence through drilled crankshaft to crank-pins. Other parts lubricated by splash from constant trough level. Oil overflowing trough returns through strainer to sump.

FORM NO. 2

The following notes apply to column heads on Motor Testing Form No. 2:

Each run should be given a number for convenience in referring to the original data sheets.

The time of day at which the run is started should be recorded.

No space is provided for the time (of day) at which the run is ended, but this reading should be recorded on the log-sheet so that the precise duration can be checked.

R.P.M. should be invariably taken from positively driven counters which engage at the beginning of the run and disengage at the end of the run. The difference between the two readings, divided by the length of run in minutes then gives the *true average* speed. Tachometers, even when carefully calibrated, are subject to possible variations, which render them unreliable; hence the necessity of using a counter for all precise records of revolutions in a given time.

Readings of pull on the brake-arm should be checked by platform scales whenever possible. A spring-balance may be used but in this case it should be carefully checked at frequent intervals. A tripod placed on a platform scale and arranged in such a way that the arm of the dyna-

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GASOLINE MOTOR TESTING FORM No. 2.

PAGE _____

DATA TAKEN IN TEST OF _____ TEST No. _____

FOR DETAILS OF MOTOR AND ACCESSORIES, AND CURVES SEE FORMS NOS. 1 AND 3 DATE _____

BRAKE—HORSEPOWER TEST*

RUN NO.	TIME OF DAY H. M. S.	DURATION OF RUN MIN.†	REV. PER MIN.	LBS. PULL AT 63.625 IN. RADIUS	BRAKE H. P.	TEMPERATURES F°			LBS. FUEL CONSUMED		REMARKS
						AIR ENT. CARB.	JACKET-WATER		PER HOUR	PER B.H.P. HOUR	
							IN	OUT			

FRICTION—HORSEPOWER TEST (MOTOR DRIVEN BY DYNAMOMETER)

RUN NO.	TIME OF DAY H. M. S.	DURATION OF RUN MIN.	REV. PER MIN.	LBS. PULL AT 63.625 IN. RADIUS	Friction H. P.	I.H.P. = Fr. H.P. + B.H.P.	MEAN TEMP. F° JACKET-WATER	REMARKS

*Brake-horsepower should not be recorded on forms 2 or 3 until the motor has been run in sufficiently to show no appreciable difference in friction before and after a run of thirty minutes at the speed of maximum torque with the throttle wide-open.

† The duration of brake-horsepower tests recorded on this form should in no case be less than three minutes and where fuel is measured not less than five minutes. The duration of friction-horse-power tests should not be less than one minute.

With a Brake-Arm 63.625 in. Long, $\frac{\text{LBS. PULL} \times \text{R. P. M.}}{5252}$ = H. P., and Lbs. Pull × 5.29 = Torque in Lbs.-Ft.

mometer is connected to it by a suspended spring-balance is recommended. The spring-balance should be connected to a knife-edge at the proper point on the dynamometer arm. A suitable counterbalance is then arranged to compensate for the weight of the tripod and the balance, so that the scale balances at zero when the dynamometer arm is disconnected. When so arranged the spring-balance gives a quick reading of pull sufficiently accurate for preliminary tests, and also serves to cushion the plat-

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form scale from shock and vibration which might otherwise be transmitted to it. When adjustments are completed and final readings are to be recorded, these are taken directly from the platform scale, which is kept balanced. Thus the possibility of error through the use of the spring-balance is eliminated.

BALANCING DYNAMOMETER

Before any readings of torque are recorded, great care should be exercised to see that the dynamometer itself is properly balanced. With the electric-cradle type of dynamometer this balancing is accomplished as follows:

The dynamometer is allowed to run idle as a motor (drawing current from the line) and a suitable counterbalance on the field frame—which should be perfectly free to turn within limits in ball bearing trunnions—is then adjusted so that the platform scale reads zero. This reading should be obtained with the dynamometer rotating first in one direction and then in the other. The reaction of the armature on the field frame will exactly balance the friction of the brushes and armature bearings carried in the field frame. With the armature still rotating, check-weights (or pieces of metal having a known weight) should be hung from the knife-edge on the dynamometer arm. If the reading recorded by the platform scale is equal to the known weight applied, the dynamometer may be considered as balanced.

TEMPERATURES

A reliable straight glass stem thermometer should be placed near the carbureter air-inlet in order to measure the temperature of the air entering. This thermometer should be read at least once during each run.

Thermometers should also be placed in suitable wells or sockets, one near the inlet of the pump, and another as close as possible to the water-outlet of the motor. These wells or sockets should be in pipes that run full, so that water continually circulates about them. They should be filled with oil or mercury, and careful readings taken at least once during each run.

Note.—In order to approximate as nearly as possible road conditions, cold water from the city main should not be allowed to enter the cylinder jackets without first being mixed with warmer water from the outlet of the cooling system. This may be accomplished by allowing the hot water from the motor to discharge into a tank with a filler pipe near the top. Sufficient cold water is then added to the hot water entering the tank to obtain the desired inlet water temperature. For motors with forced circulation the inlet water temperature should preferably not fall below 120° F., and for motors with thermosyphon cooling below 80° or 90° F.

FUEL CONSUMPTION

Fuel consumption is best measured by noting the decrease in weight of a tank from which fuel to the carbureter is being drawn. The tank should be placed on sensitive platform scales at a proper level above the carbureter, and connected to the fuel-supply pipe by a short horizontal

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length of rubber tubing. This tubing should be very flexible and should not be drawn taut, so as not to interfere with the weighing. Weighings should be made as follows:

Set counterpoise so that scale-beam will fall just as the run is started. Note the setting and the time at which the scale-beam falls. Move the counterpoise back to the next pound mark, or to such a point that it will fall just before the end of the run, and note carefully the time when beam again falls. From the difference between the two times and the two weights recorded, the fuel consumption per hour can be readily determined.

FRICTION-HORSEPOWER

Friction-horsepower of a motor can be best measured by means of an electric dynamometer, preferably of the cradle type. The dynamometer is used to drive the engine under test at various speeds, and the torque reaction measured. This will be in the opposite direction to that obtaining while the motor is driving the dynamometer, so that provision must be made for weighing the torque on both sides of the dynamometer, or else suitable linkage must be provided to change the direction of the pull. The test for friction-horsepower should be made immediately after the brake-horsepower test, and before the motor has cooled, in order to keep the condition of the lubricating oil and friction obtaining when the parts are hot as near as the running condition as possible. During this test the throttle of the motor should remain wide open. Compression cocks should remain closed and all accessories, such as magneto, pumps, etc., used during the brake-horsepower test should be in operation.

INDICATED-HORSEPOWER

The approximate indicated-horsepower is obtained by adding to the brake-horsepower at any given speed the friction-horsepower obtained at the same speed.

If the friction-horsepower and brake-horsepower tests are not made at exactly the same speeds, the friction-horsepower at any given speed can be obtained by the use of the curves plotted on Form No. 3. Difficult interpolation is thus avoided.

MEAN TEMPERATURE OF JACKET-WATER

During the friction-horsepower tests the mean temperature of the jacket-water should be recorded. If the water is circulating the average of the inlet and outlet temperatures may be taken as the mean temperature. If thermosyphon circulation is used the water will not circulate during the friction-horsepower runs, and the mean jacket-water temperature should be taken if possible by inserting a thermometer into the jacket space and noting the average temperature.

FORM NO. 3

In using hydrometer to measure gravity of fuel, care should be taken to record fuel temperature.

After word "dynamometer" give type and name of brake used.

Length of brake-arm.—For ease in computing, a brake-arm having a

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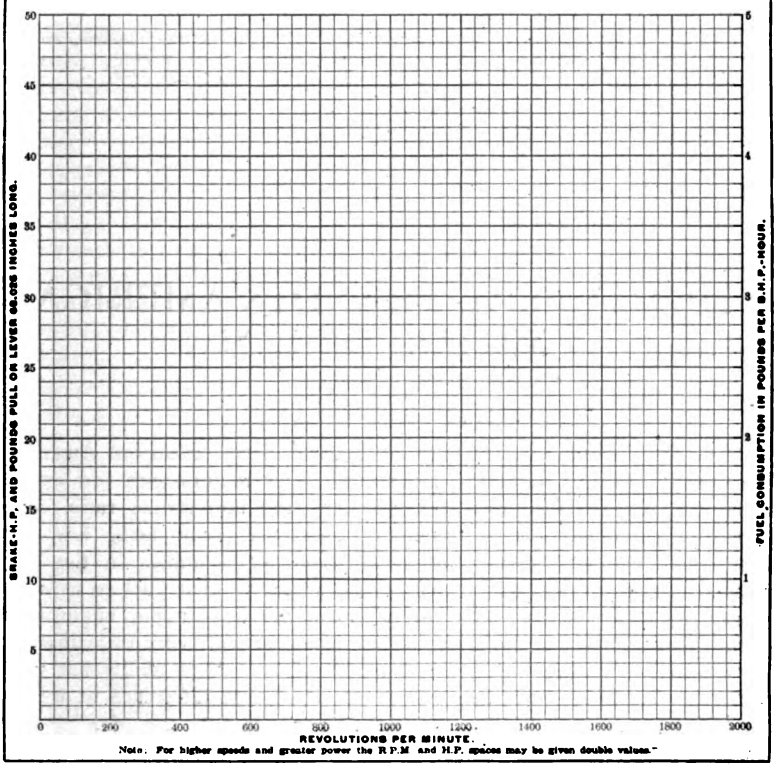
GASOLINE MOTOR TESTING FORM No. 3

TEST CURVES OF _____
FOR DETAILS OF MOTOR AND ACCESSORIES SEE FORM NO. 1

PAGE _____
TEST NO. _____
DATE _____

KIND OF FUEL _____ BAUMÉ, DEG. _____ AT _____ °F. B. T. U. PER LB. _____
AVERAGE TEMPERATURE OF AIR DURING TEST _____ °F. BAROMETER, IN. _____
AVERAGE TEMPERATURE OF JACKET-WATER DURING TEST, INLET _____ °F. OUTLET _____ °F.
TEST MADE BY _____
ASSISTED BY _____

MAKE OF
MOTOR _____
DYNAMOMETER _____
CARBURETER _____
IGNITION _____
SPARK PLUGS _____



length of 63.025 inches (measured horizontally from center of dynamometer shaft to point where arm rests upon or is connected to scale) is most convenient. With this length of arm, to find the horsepower, it is only necessary to multiply the pounds pull, measured by the dynamometer, by the r.p.m. and point off three places (*i. e.* divide by 1000).

To obtain the torque of the motor in *pounds-feet* from the pull recorded on an arm of this length, multiply the reading by $\frac{63.025}{12} = 5.25$.

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For an arm 31.513 inches long, horsepower $= \frac{\text{pull} \times \text{r.p.m.}}{2000}$. For other lengths of arm use the formula $\text{H.P.} = \frac{\text{pull} \times \text{r.p.m.} \times 2\pi \times R}{33{,}000}$ where $R =$ length of brake-arm in *feet*.

Note.—With an arm 63.025 inches long the pull for a given horsepower is inversely proportional to the speed. For this reason the same ordinate may be used to designate pull and horsepower on a curve plotted with r.p.m. as abscissae.

Sets of the forms can be purchased at the S. A. E. office at the following prices:
Single sets.....5c each
Fifty or more sets.....3c each

Presented at
Metropolitan Section Meeting

THE GENERAL TREND IN AMERICAN MOTOR DESIGN

By W. M. Power
(Member of the Society)

The question as to the lines of general development of American motors is becoming more and more vital. Our motors with few exceptions are characterized by large cylinders, the bore-stroke ratio, compression, piston speed and maximum output per pound being low, and fuel economy being almost neglected. Our shortcomings in the last-named respect are generally met by the argument that fuel is so comparatively cheap in this country that the matter is of minor importance. Granting that there is some reason in this argument, very little thought is required to realize that for two motor cars of given ability but wide difference in motor size and weight and co-related difference in weight of the complete car, the item of fuel economy is only one of a number making for low operative expense. As contrasted with the general practice here the European manufacturers, notably the British, have gone to what perhaps appears to us the other extreme, building motors having almost exactly opposite characteristics and getting power outputs which a very few years ago would have been considered impossible; this being coupled with a fuel economy beyond anything with which we are familiar.

These results have been attained by very large valves and ports, designed to give as smooth flow-lines as possible, high compression, and very high piston speeds, well above 3,000 feet. Such engines must be driven carefully if they are to give their maximum in service, piston

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speeds must be kept up only if a reasonably large power output is required, and the motor must never be allowed to run on wide-open throttle at low speeds. This means, of course, the gear-changing will be much more frequent, and that a change down will be required for any piece of bad road whether hilly or not.

Granting, however, that these requirements are complied with, the results are altogether gratifying. The motor, although sensitive, becomes for the man driving his own car, an intimate thing, a part of himself almost, willing and able to give good and long-continued service, and at an operating cost that is surprisingly low. In addition to care in driving one other thing is, however, absolutely necessary: Occasional adjustment and periodic overhaul must be carefully made. The ordinary methods of doing work which it is to be regretted are only too prevalent in the average garage repair shop will not do; a kick and a curse will not keep motors of the type under consideration in condition to operate satisfactorily.

Each of the types of motor has advantages peculiar to itself, from both manufacturing and operating standpoints, and the most comprehensive discussion of them possible is fully warranted. Given proper equipment in the shop the workmanship required in the case of the two types is about the same for really good construction, except that the light connecting-rods and pistons for the small motor, together with its lubrication system, will entail a slight additional expense. This is more than compensated for by the smaller amount of material required and the smaller parts to be handled. The final assembling and adjusting of the small motor cost more.

The probability is that the most suitable motor for service in this country is a compromise between the two types, designed to give well-sustained torque up to about 2,000 feet piston speed; and having for a five-passenger car about 4,000 to 4,500 c.c. displacement in the case of a four-cylinder motor and about 5,500 to 6,000 c.c. in the case of a six.

For the piston speed specified motors of about 6-inch stroke should have clear valve diameters of about 50 per cent. of the cylinder diameter, the lift being about 3/8 inch, and there being ample clearance between valve head and combustion chamber wall; the area of the annulus between valve head and pocket wall being one and one-third times the effective area of valve-opening. The combustion chamber should be about 25 per cent. of the swept volume of the cylinder. Straight-sided cams with mushroom or large-diameter roller tappets, with usual timing (i. e., exhaust opening about 45° to 48° before bottom to 10° after top center, with inlet opening 5° after top and closing 30° to 35° after bottom center, will be found sufficient.

Piston design should be carried to the last limit of lightness consistent with safety; 90-mm. pistons of good gray iron, with three rings at the top and a scraper ring at the bottom, weighing 24 ounces, with rings but without wrist-pin, have stood up well. For 95-mm. diameter the weight will be about 28 to 29 ounces, and for 100 mm. 32 ounces will be found sufficient. It is essential that such pistons be cast with cores carefully

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made in metal boxes, and the arrangements for machining them should be such as to allow accurate setting up from the inside.

A ring arrangement which has been found very satisfactory and which lends itself to very light construction is as follows: A single broad groove about 3/16" to ¼" from the top of the piston is used, the depth being about 7 per cent. of the piston diameter. In this groove three rings are fitted, a broad concentric hammered ring filling the bottom half approximately when contracted. The ring is ground on the top and edges. Superposed on it are two narrow rings which side-by-side fill the balance of the groove. These twin rings are ground all over to conform to the cylinder and have no tension, dependence being placed on the broad bottom ring for keeping them in contact with the cylinder walls. The joints in the twin rings should be staggered, pins in the broad ring holding them in position. It has been found that with full forced lubrication it is impossible to make a motor fitted with these rings smoke, even after running for long periods with an almost closed throttle. The oil consumption ran well over 1,200 miles per gallon.

Pistons of the weight we are considering are so thin as to be very easily distorted and advantage of this can be taken to preclude the possibility of noise through side-slap. The piston can be machined to fit the cylinder except at a narrow relieved portion next the head. A second operation removes from .008 inch to .010 inch from the sides of the piston in line with the ends of the wrist-pin and for its entire length up to the relief next the head. This metal can be removed by a second grinding operation, the cut running out so as to leave a land in contact with the cylinder wall in line with the thrust of the connecting-rod and embracing about one-quarter of the piston circumference both front and rear. Such a piston when expanded by heat will be distorted so as to more nearly fill the cylinder. The pressure required for such distortion is, however, exceedingly light and the possibility of seizing and cutting entirely eliminated.

The second vital feature for high-speed motors is the connecting-rod which should be made either hollow, an expensive construction, or of a rather shallow I-section. The deep I-section is difficult to forge and it is still more difficult to keep the weight down owing to extra metal which must be allowed for draft in the dies. A reforging operation will remedy this to a large extent, but is again expensive and the dies are not durable using the quality of steel necessary, which should be good chrome nickel. The shallow I, on the other hand, can be made with reasonably thick flanges and thin web and very little extra section need be added for draft. Two well-fitted bolts of about ½ inch diameter and good material are sufficient and make for low cost and weight.

Rods should be carefully balanced both for big and top ends. Valves should be made with narrow seats and the stem and head joined with a large-radius fillet; ¾-inch is not too great. Springs must be heavy enough for sufficient acceleration to force the tappet to follow the cam profile at the proposed speed.

The lubrication system is perhaps of more importance than anything

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else as affecting durability, except light-weight reciprocating parts. A full forced system is probably the most satisfactory, with maximum pressures up to 25 pounds. Bearings should be made with not more than one circular oil groove, to which the lead from the pump is taken and with which the lead to the center of the crankshaft registers. Oil is carried to the crank-pins through drilled webs. Pins should be hollow with plugged ends, or better still, a piece of tube with outside diameter about ⅛ inch less than the bore of the pin can be inserted, the tube being expanded at each end to fit inside the pin at the ends only. Oil is led to the annular space, an oil-hole from it registering with a circular groove on the rod bearing.

Broadly, it seems that the moment the purchasing public realize that for given service with the average type of car being built in this country, they are paying altogether too much, there will be a very marked demand for the smaller and more economical machine.

DISCUSSION

CHAIRMAN ANGLADA:—Is the piston speed you refer to as well above 3,000 feet the maximum piston speed?

W. M. POWER:—The maximum piston speed is very much above 3,000, approaching nearly 4,000 feet. 3,000 feet refers to the speed at which the torque is well sustained.

F. R. PORTER:—We closed the inlet at 65° past bottom center. My experience has been that with a motor designed for 2,300 feet piston speed, and even with a motor of 2,900 piston speed we were held back considerably if we did not carry the inlet closing that far. Two years ago we carried it over 45 and then increased to 50 and finally to 65°. We find in practice that at extreme engine speeds the valves remain open even longer, because they jump.

W. M. POWER:—Valve timing, valve and port design and exhaust gas interference are all co-related. Their influence has to be balanced up. Wide variations are obtained in two men's experience, using motors of the same size. I have seen a six-cylinder, 4⅜ x 6¼ motor which showed a very consistent torque up to 2,000 feet with valves of a diameter less than half the cylinder diameter. But we were careful in that case to avoid exhaust interference, and the layout was very studiously made too. The six-cylinder 4⅜ x 6 gave 114 horsepower at 2,100.

F. R. PORTER:—Did you not have some valve jumping at the high engine speeds?

W. M. POWER:—The valves may have stayed open longer than the timing would indicate, but I think not.

CHAIRMAN ANGLADA:—I think Mr. Pope took up the matter of the manufacture of foreign-type engines versus American-type engines with some motor manufacturers some six months ago.

N. B. POPE:—I did look into the matter to a certain extent, chiefly because I was impressed with the argument that if you wish to increase the power of the motor you can do so by increasing the size of the motor or its speed. The European designers have chosen the latter alternative,

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which seems, broadly speaking, good economy. In order to secure that economy, however, they have to compel their users to learn to handle the motors very differently from what our users handle them here. It seems that the fact that the high-speed motor is very much more sensitive to the throttle than the low-speed and "sluggish" motor will probably constitute the principal objection to it in this country, with the second objection of higher cost to the manufacturer, due to the closer limits which are necessary, the more expensive design and possibly more expensive materials. One consulting engineer in Detroit wrote me plainly that so long as American automobile manufacturers are unwilling to pay more than $150 for their motors we will continue to have "sluggish" motors. He did not indicate that he had a particular preference for that type, but seemed to think that our manufacturers are not sufficiently alive to the value of the lighter, high-speed type, or else do not consider it commercially expedient. I think it would be interesting if we could get some opinions tonight on the question of what may be termed the economies of increasing motor speeds; because it is just a plain question of getting more horsepower for less metal if you can speed the motor up. It is only necessary to determine what you must pay to get that advantage and whether you can afford to pay it.

CHAIRMAN ANGLADA:—There is an enormously strong feeling throughout our entire country against gear-shifting. During the past five or six months a dozen or more engineers have told me that they hesitate to go to the high-speed light motor solely on this ground.

Mr. Power alluded to a very much mooted question, the number of big-end connecting-rod bolts.

W. M. POWER:—I have never seen a two-bolt construction give any trouble when properly fitted, put on with light parts. I have seen four-bolt construction give trouble when the bolts were too small, simply because the design was improper.

F. R. PORTER:—I have always used four bolts, the principal reason being that we found we could get a great deal lighter big-end with that construction.

W. M. POWER:—To maintain that lightness you have to build a great deal more expensive rod than with two bolts.

F. R. PORTER:—Yes.

W. M. POWER:—I believe that two bolts are entirely satisfactory.

N. B. POPE:—I would like to read into the record a short extract from the *Autocar* dealing with the weight of iron and pressed steel pistons. The particular piston referred to is the Zephyr, which is made of pressed steel sections welded together. The weights given refer to well-known cars, and I will state them. The Ford piston regularly fitted in the engine—56 ounces; steel piston, 22⅛ ounces. Austin car, existing weight, 76½ ounces; steel piston, 37⅛ ounces. Fiat, existing weight, 34 ounces; steel piston 17 15/16 ounces. Talbot car, existing weight, 55½ ounces; steel piston 27⅜ ounces.

W. M. POWER:—The piston construction I spoke of, with the triple

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ring, that is, uniting the three rings in a single groove, eliminates a lot of metal which you usually get with three grooves. There is a lot of metal you cannot do away with in the usual construction. By combining the rings in a single groove, you get a lighter section and still get a very tight piston.

N. B. POPE:—That is, I assume, a very expensive piston to make?

W. M. POWER:—Yes, the ring is expensive to fit up.

M. R. MACHOL:—That same Ford piston of magnalium weighs 18 ounces; that is made from the same pattern as the iron piston.

HERBERT CHASE:—I would like to ask if Mr. Powers advocates a five-degree overlap of the valves?

W. M. POWER:—Yes, provided there is no exhaust interference at all.

HERBERT CHASE:—That would require a double manifold on the six and possibly on the four, would it not?

W. M. POWER:—It should not on the four. It does on the six.

HERBERT CHASE:—With the double manifold on the six, do you advocate the same overlap as on the four, practically?

W. M. POWER:—Yes.

HERBERT CHASE:—Do you think that overlap would not interfere with the distribution, if the design were properly worked out?

W. M. POWER:—Yes.

CHAIRMAN ANGLADA:—Mr. Power contends that the full forced lubricating system is the most satisfactory, with maximum pressures up to twenty-five pounds. I would like to know whether he understands from experience that such a system is really warranted.

F. R. PORTER:—I have never had much experience with any of the full forced systems, because I have always used the splash and never have had any occasion to change. It has been perfectly satisfactory. We have used force for the main bearings, much higher than twenty-five pounds, as high as fifty. In most of the big motors we use a very large pump, with a capacity of three quarts a minute, with the idea of cooling the bearings. In tests we got pressures up nearly to 400 pounds; that is, when the bearings were new and fitted very tight. The pump is built for 600 pounds. What it worked at normally after the bearings became loosened up, I do not know. We use a scoop, taking the overflow from the main bearings on the crank arms, which throws it to the connecting-rod bearings, and we have never had any trouble.

CHAIRMAN ANGLADA:—Do you feed oil under pressure to the crank-pins?

F. R. PORTERS—No, only by centrifugal force. We had a motor under a seven-hour test, wide-open, and have never had any trouble.

HERBERT CHASE:—Mr. Chairman, I might say one or two words as to the lubrication of the Knight motor which was recently tested in the Club's laboratory. It had what I think may be termed a full forced lubricating system. There were no grooves in the bearings, that is no grooves running lengthwise of the bearings. The rods were hollow. I understand that when the motor was originally designed the oil was forced up through the hollow rod to the wrist pin bearings, but this

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resulted in the rod filling full of oil, so that its weight was very much increased. In the motor as run under the test, the hollow rod had been drilled with a one-eighth inch hole about three inches above the big-end center. Until that was done the motor had altogether too great a supply of oil on the wrist-pin end. It was found, however, that sufficient oil to give proper lubrication was forced up through the hollow rod, even with the one-eighth inch hole near the lower end, enough oil flowing through the hollow rod to the hollow wrist-pin and from the wrist-pin out through holes in the sleeve valves to the cylinder walls. The sleeves themselves were evidently lubricated to a sufficient extent.

CHAIRMAN ANGLADA:—Do you know what pressure was used in that system Mr. Chase.

HERBERT CHASE:—We made no test to determine the exact pressure, but my recollection is that Mr. Vandervoort, president and engineer of the company which built the motor, said that the pump originally gave a pressure of about forty pounds. This pressure was gradually cut down until it was found, I believe, that four or five pounds was sufficient.

W. M. POWER:—Was the oil-feed pressure reduced to decrease the smoke?

HERBERT CHASE:—Yes, the higher pressure fed altogether too much oil.

Presented at Metropolitan Section Meeting

RACING AND ITS EFFECT ON MANUFACTURING

By FINLEY R. PORTER
(Member of the Society)

The topic, "Racing and Its Effect on Manufacturing," is one so subject to varying opinions that to define the difference between cause and effect in a manner to be convincing is somewhat of a task. I will endeavor, however, to present only such features as appear to be borne out by facts as I have seen them during four years of intimate connection with this branch of the art. The fact that the results obtained are so decisive and so easily affected by the human element, shows that a clear understanding or true analysis of the different points at stake are, as a result, often misconstrued. Generally speaking, the results obtained, and the satisfaction in use, in practically every case, are the same for racing as touring, except they are had in a magnified form in the latter.

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First, motor efficiency seems to have been in the early stages of the art subject to more attention than any other feature of road vehicles, due no doubt to its being the most radical departure from conventional practice known to the engineering world at the time. During the period between the early 80's and 1896, the development of the internal combustion engine seems to have been rather slow, when considered from an efficiency standpoint, while the forms of vehicles during this period changed considerably, developing as they did from the tricycle type to a substantial four-wheeled vehicle.

After this time road racing was considered very seriously, the first instance where competition seemed to develop to a very keen point occurring in 1896 just after the Act of the English Parliament that abolished the necessity of preceding a motor-propelled vehicle with a red flag. The first real race held in England was a non-stop run to Brighton, starting from London. The entry list was very large, including what was then the best effort of such men as Leon Bollee, Daimler, Levassor and Duryea (representing the United States). Following this event the necessity for greater power and general weight limitations seemed to be recognized by the leaders, with the result that the cars used for racing seemed to develop much more rapidly than pleasure cars. This was no doubt due to the fact that most of the purchasers were necessarily men of wealth and lovers of sport.

Up to, perhaps, 1903, there was no question that racing alone was responsible for the development of the automobile. From that period to, perhaps, 1906 or 1907, the energy of the leading automobile designers still seems to have been centered more largely on the development of the speed car, while the pleasure vehicle seemed to be a modification for use under less strenuous circumstances. From 1907 to the present time a great deal more attention has been paid to luxury than to speed, but at the same time the leading minds have continued to develop their theories and investigations by racing. Through all of this period the development of the motor has been the paramount issue, and all of the important results necessitated experiments beyond capabilities in ordinary touring uses. Since practically all of the real development in motor design has centered on the four-cycle motor, a number of types have been brought into favor, all with more or less success, current work becoming simply a question of perfection of details. The results obtained from each experiment conceived as a means of producing a machine to conquer, are, I believe, invariably introduced into the pleasure vehicle, resulting not only in betterment of the same, but in more advanced methods of manufacture. We can understand readily that while the advances made in manufacturing processes are not usually attributed to the effects of racing, they are most assuredly a direct result from it.

My personal experience has been along the lines of development of the conventional T-head motor. This, since the advent of the two-point high-tension ignition, seems to be capable of very nearly the same results as the valve-in-the-head motor, permitting one at the same time to keep within the bounds of stock possibilities, as accepted by the general public.

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While I am not a believer in stock contests, I have always accepted each new successful development as a means to further the ends of my stock production.

I have carried compression ratios as low as 19 per cent. of the total volume, giving a mean effective pressure of practically 100 pounds per square inch, with no signs of preignition. A much higher factor of safety is, however, needed in the strength of the cylinder heads, due to the constructional features involved in a T-head cylinder with large port areas. The surface presented in the combustion chamber is a very broad one, with not much chance of reinforcement by ribs or dome effect, which seems to result in a tendency to "weave" that eventually causes failure, due to a fatigue effect, apparently, rather than to inherent weakness of cylinder walls. My conclusions in this respect are borne out by the fact that the most strenuous tests fail to develop any initial weakness, yet after constant use fractures around the extreme top of the cylinder wall seem to occur quite frequently. This result, together with the fact that I have never carried a stress on a cylinder at this point above 5,000 pounds per square inch, while test bars from the cylinder material often give more than 34,000 pounds per square inch, seems to bear out my conclusion. Experiment as radical as this in the development of a stock motor would have seemed ridiculous three or four years ago, and only the urgent need of more power from the same cubical contents was incentive enough to try it, thus reaping the benefit probably two years sooner than would otherwise have been the case.

Light reciprocating parts also became a necessity, demanding the use of the highest class of material. In an effort to decrease the angularity of the connecting-rod, permitting the use of longer strokes without any greater loss in transmitting the explosive force to the crank-pins, very long connecting-rods became a necessity. I have used successfully chrome vanadium steel for these parts, stressed to 60,000 pounds per square inch. Moreover, steel pistons, turned to a thickness at the lower end of less than 1/16 inch have proven satisfactory in every respect. The two important factors mentioned are receiving a marked degree of attention from all designers, and while they are not in common use in stock production as yet, there is no doubt that within the next two years they will be accepted as necessities in the stock car. While I have never used the constructional features mentioned in reference to the cylinder shape in a stock car, I have found that the limits can be carried to the same extremes as in racing, without producing any ill effects in a stock car, the reasons being that in no instance does stock use demand such strenuous service, and owing to the fact that the carbureter is never held wide-open for any length of time, the volumetric efficiency must fall off and the explosive pressure consequently be very much diminished. The same theory holds good in reference to the lack of urgent need for such extremely high motor speeds, permitting the use, without any apparent falling off in power, of heavier reciprocating parts that might be resorted to purely as a means of reducing the cost. There is not a single thing, however, in the motor used in the car which won the Grand Prize race at Santa Monica in 1914, for

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example, considered from either a cost or extremes in construction standpoint, that I would hesitate to use on a stock job; the point being that such use is hardly demanded.

In the use of light reciprocating parts and high compression, the necessity of large port areas is obvious. While several different proportions of valve to cylinder diameter have been advanced as the proper method of determining valve sizes, my practice has been to keep the gas velocities as low as possible, consistent with good carburetion. Eight thousand feet a minute maximum has been arrived at as correct, but I have no figures or experimental results to prove that this is the limit, or the correct solution of such a seemingly important factor. The volumetric efficiency obtained, however, proves beyond doubt that this ratio is very good, if not the best. The maximum torque, in the case of the motor mentioned, was 285 pounds, and was carried as high as 2,250 r.p.m., while the maximum horsepower was reached at 2,350 r.p.m., the motor developing at that point 150 horsepower. The several attempts to increase motor efficiency have forced upon us a marvelous increase in piston speed, and positive results have been obtained that no doubt would never have entered the designer's mind when considering stock production.

As an important factor bearing on the matter of piston speed, valve timing has come in for a generous share of consideration, and while experiments along this line are comparatively easy, the wonderful results are demonstrated only by the fast-moving vehicle. This again comes back to the racing car for demonstration. Placing the opening of the exhaust as early as 70° ahead of center, and closing the inlet valve as late as 63° past lower center, with practically no attention paid to the closing of the exhaust and the opening of the intake, within reasonable limits, have been proven thoroughly practical and efficient, in stock production, as well as racing; and to racing alone I believe this development is due.

Chassis development followed motor development closely, being taken up earnestly as early as 1906 or 1907. The need, however, for anything radical was not pressing until within the last three or four years. The matter of straight-line drive, with a low center of gravity, was the first pressing need developed in racing, which has worked out wonderful results in stock practice.

The matter of power transmission to the rear axle, through the various forms in use, has reached a high state of development, and in the case of the shaft drive, so well adapted to all types of cars and now in such common use, owes its early development, I believe, entirely to racing.

The search for lightness, so essential for the unsprung parts of the chassis for racing, led to the use of the best of alloyed materials, making possible quietness, as well as lightness. To just what extent this development would have reached in so short a time, except for racing, is problematical, but my impression is that we would have been years behind where we are now.

No longer ago than 1910 the question whether a racing car could be equipped with a shaft-driven axle, with any degree of success, owing to

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the excessive weight, was a matter of very common discussion, the chain drive being the only type considered fit for racing, owing to the fact that it permitted such light construction as compared to the construction with differential as in use at that time. At the present time, however, our latest interpretations of what the lightest racing car should be discloses the fact that it is equipped with shaft-driven axles.

Ease in riding is also a development resulting, I believe, directly from racing. In racing the need of easy riding qualities has been neglected to a great extent, but the necessity of being able to keep the wheels on the ground led to a great amount of experimenting, to discover the best possible means for accomplishing it. All manner of shock-absorbing devices gave way to the conclusion reached that the sprung and unsprung parts must necessarily bear a given ratio one to the other. My personal experience has indicated that 25 per cent. in front and 35 per cent. in the rear is about the limit of the unsprung parts to that above the springs, the result being that slippages of not over 1 per cent. to 1½ per cent. are to be had, while several years ago 5 per cent. was not considered excessive. Experiments disclosed the fact that easy riding was merely the result of keeping the wheels on the ground, and not, as commonly supposed, a factor to be considered by itself. While the importance of the above-mentioned consideration is illustrated vividly in racing cars, owing to the light weight desired, the body and passenger load in pleasure vehicles relieves the necessity for lightness to a great extent. In the matter of rear axles for our racing cars, we have been able, by the use of chrome nickel and air-hardened steels, to get the weight of the entire differential unit, including the carrier, down to 39 pounds. The limit of this weight was governed, not so much by the strength of the materials, as by the proper section to make gear hardening possible. The same units in stock cars weigh practically 90 pounds, this being the weight necessary for the sake of strength, owing to the use of relatively poor material. My belief is that while the urgent need of lightness in this part does not go to the extremes that it does in racing, it will be money well spent, and would necessarily better the riding qualities, and also increase tire life, inasmuch as it would reduce materially tire slippage, and is one of the points easily gained, demanding only a slight increase in the cost of material, and the use of a reasonable amount of ordinary judgment in design.

Spring suspension is also a matter worthy of consideration in stock cars as well as in racing, but in the case of the pleasure car its line of development seems to be somewhat neglected, everybody being prone to follow conventional lines. The bringing out of the so-called cantilever suspension is a big advance in the matter of light unsprung parts, placing as it does, the weight of the springs on the sprung portion. I recently attempted the modification of driving through the springs rather than the radius rods, in an attempt to overcome the tendency to buckle the spring, and destroy the ribbon action, which happens in the case of driving through the front end. This I accomplished by virtually pulling

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the car through the use of the semi-elliptic spring, fastened permanently to the rear end and shackled to the front, my theory being that putting the spring under tension instead of compression would materially help this ribbon action, and do away with the necessity of increasing the spring strength, as is necessary when driving through the front end. This was applied to the Grand Prize Mercer cars, and was also tried out in stock car experiments covering a period of several months. The conclusions reached are that it is worthy of consideration. It made a hard-riding racing car ride as easily as any touring car. Just how much of this accomplishment can be credited to the manner of spring suspension is problematical, owing to the fact that we decreased the weight of the unsprung parts in other directions at the same time. The tendency, however, for the car to settle when the power was applied, rather than jump up in the common manner, leads me to believe that a great portion of the results was due to the spring suspension.

This seems like an argument against the cantilever type of spring, inasmuch as it is almost necessary with it, if driving through the spring is resorted to, to put the spring under compression. The manner described, I believe, would not only be more economical, but fully as good as the cantilever type, with a number of distinct advantages.

While many designers, working solely in the commercial field, will no doubt resent some of the broad assertions made in this discussion, they are in reality only copying the conclusions reached by men who produced formulas and tables of results by employing methods as described, the necessity of which, I believe, had its inception in racing. Each of the points at issue, considered only in respect to itself, does not appear far-reaching, but the general trend of modern automobile design is, and has always been covered, to my mind, by the above issues broadly considered.

Two of the most pronounced illustrations of this assertion, I would say, are the 6-cylinder motor and the sleeve type of motor. Neither of these seems to have had its inception in racing, but a close analysis of the inherent principles, will, I believe, show that these motors became possible only as a result of the wonderful developments of the 4-cylinder and poppet-valve types. The L-head motor is another type that apparently has no value as a racing motor, it no doubt having had its inception in an endeavor to decrease weight. The fact that a single camshaft resulted in greater quietness, was a development rather than a consideration when first designed.

The streamline body, which has found great favor, since the comfort possible is so great, is, to my mind, a direct result of the wonderful advantages shown in racing bodies, developed purely as a means of decreasing the wind resistance, which is such a great detriment to speed.

The wire wheel had its inception in racing, as a means to an end, to get an exceptionally strong wheel with a great decrease in weight. This development came along with the recognized necessity of lightness in the unsprung parts, and was by no means the smallest factor that

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had to be dealt with. The easy-riding qualities of this wheel would hardly have been known if necessity had not demanded its construction.

Generally, and in conclusion, I would state that even in the midst of such wonderful examples of the modern designer's ability, and bearing in mind the remarkable development introduced by our metallurgists, it is surprising to note the new things to be learned at every race meet. Prominent among these is the fact that so many undue stresses on the chassis seem to occur, that cannot be figured in any way, but are demonstrated plainly in a racing car. This applies to all parts of the car, and illustrates fully that fatigue-resisting metals must be used practically throughout. Keys, holding gears that have pressed fits, and other minor parts, such as magneto-drive shafts, pump shafts and the like, that appear in ordinary carbon or nickel steels to be more than strong enough, considered from the standpoint of known stresses, will rupture frequently and at unequal periods during the life of a racing car. An easy way to be safe is to use the highest quality of chrome nickel or vanadium steels, thoroughly heat treated, the cost of which is nominal.

No doubt the same condition prevails in numerous failures on pleasure cars that are often attributed to misuse or neglect. Occurring, as they do, however, at long intervals, the real reasons are seldom sought, and consequently the right conclusions are seldom reached.

The adoption, in my stock production of the past four years, of the principles stated, has resulted in cutting the up-keep cost of pleasure cars almost in half.

Although all designers do not participate in racing, the general results shown and talked of, are found to be the subject of discussion in almost every quarter—consequently in stating that my belief is that racing is directly responsible for the development of the modern automobile, which means that manufacturing facilities must keep pace with its development, I have no fear of contradiction, provided the subject be given unbiased consideration.

DISCUSSION

H. W. SLAUSON:—What is the weight of your racing motor per brake horsepower?

F. R. PORTER:—About five pounds. It weighed just under 800 pounds.

H. W. SLAUSON:—If the unsprung weight of the chain-driven car is less than that of the shaft-driven car, I should think it would hold the road better. How is that point overcome in the shaft-driven car?

F. R. PORTER:—The shaft-driven car is not very much heavier.

MR. WHITMAN:—I would like to inquire what saving in weight there is in the use of wire wheels over wood for racing.

F. R. PORTER:—There is very little saving in the total weight, but most of the weight is in the hub of a wire wheel, which makes considerable difference in its gyroscopic action.

MR. AHRENS:—What effect will the question of fuel economy have on

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the design of the motor which Mr. Porter spoke of, when it comes up in future races in the United States?

F. R. PORTER:—Fuel economy is something I have never striven for, but it will mean a higher speed motor, no doubt. The Grand Prize winner at Santa Monica made about thirteen and a half miles to the gallon. The limitation abroad was sixteen miles to the gallon, I believe.

Presented at
Indiana Section Meeting

FUSION OR AUTOGENOUS WELDING

BY H. SIDNEY SMITH*

Fusion or autogenous welding has during the last few years done more to revolutionize old practice in certain branches of the engineering industry than any other new process. Its introduction has made possible certain forms of construction which had previously been considered impossible or impracticable, and in the repair field has already saved manufacturers and users enormous sums. As generally practiced, it employs the heat generated by electricity or by the burning of a combustible gas with oxygen. For the combustible gas, acetylene, hydrogen or coal gas are most commonly used.

ELECTRIC WELDING

Electric welding may be divided into two classes: resistance and arc welding. The first of these is the process usually employed for welding pipe, chains, and work of like character, in special machines, where only a single joint has to be made and the demand for the article to be welded is sufficiently large to warrant the outlay for the special costly machine. The form of electric welding most commonly employed is the arc process. In this the work to be welded is connected with one pole of a source of current, the other pole being as a rule a carbon rod held in an insulated holder. This holder is manipulated by the operator so as to first make contact with the work and then effect the separation required to maintain the arc. This is a true fusion process and is chiefly employed for filling up blowholes in steel or iron castings. In a modification of this process, which it is claimed gives good results and allows of a more extensive field of operation, a steel rod is used as the positive pole instead of a carbon one. The arc is formed between this rod and the work; when the point of the rod reaches a welding heat it is pressed against the work, some of the

*Engineer of the Prestolite Company.

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molten metal from the rod adheres to the work and is then hammered in by the operator.

Apart from the vital question of cost it is generally conceded that fusion produced by the burning of gases is preferable to the electric process for the following reasons: When welding with the electric arc the intense heat is concentrated on a point, whereas with gas welding the heat of the flame can be brought to bear at will on the work surrounding the part to be welded, making it possible to gradually attain the desired welding heat at any point. With electric arc welding the light produced is so intense that the use of very dark glasses by the operator is imperative. Again, unsteadiness on the part of the workman may cause an arc to be struck between two parts, and fusion or addition of metal where it is not desired. The electric arc is formed at the expense of atmospheric oxygen; this indicates the possibility of chemical changes of an oxidizing character taking place in the molten metal, whereas with the gas process the welded part is always protected from the atmospheric oxygen by a shield of the products of combustion. Electric welding is suitable only for filling in or welding comparatively simple parts and cannot be used for complicated and other work as can the gas process. Probably the chief objection to electric welding is the fact that it is almost impossible to perform any subsequent treatment of the welded part, which is quite simple with the gas process where the area surrounding the weld and the weld itself can be gradually annealed, thus removing internal strains and taking from the welded portion its hard and brittle character. Notwithstanding these drawbacks electric welding has a large field wherein it can be employed advantageously and with better results than can be obtained with other methods of welding.

BLOWPIPE WELDING

Blowpipe welding is a process by which pieces of metal are melted and joined together by means of a flame of sufficiently high temperature, and additional metal of the same composition added if desired. The joint thus obtained is today commonly called an "autogeneous" weld. As a matter of fact the weld obtained by forge welding or by the electrical process can be called autogenous, as use of a metal cement is not necessitated as is the case with a brazed joint. But it is general today to use the term "autogenous weld" only in connection with welds effected by means of a gas blowpipe.

Blowpipe welding on metals of low melting point is a very ancient art and was practiced by the Egyptians. The welding of high-melting-point metals by means of the blowpipe flame was not made possible until oxygen was procurable on a commercial scale. Then welding by means of blowpipes, using oxygen and hydrogen, and oxygen and coal gas began to be developed, but was later more or less ousted from the field by the oxy-acetylene process. More recently the oxy-oil gas and oxy-benz processes of blowpipe welding have been introduced but their fields of operation are not likely to be large for reasons that will be given later.

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Flame temperatures produced by the combustion of a fuel gas in air or oxygen depend on two factors, the calorific value of the fuel gas and the nature of the products of combustion. Taking the case of a fuel gas with a high calorific value burning to products of low specific heat, we have a flame of high temperature, but if the products of combustion have a high specific heat the flame temperature is lowered proportionately. As an example, suppose we burned sufficient hydrogen to produce a fixed number of heat units, and then burned sufficient carbon to produce a similar number of heat units; in the first case the product of combustion would be water vapor and in the other carbon dioxide (CO_2). Water vapor, however, has a much higher specific heat than CO_2; hence the temperature of the hydrogen flame would be low as compared with the carbon flame or fire, as the flames have to supply the heat to raise the temperature of the products of combustion. With the exception of hydrogen, all fuel gases burnt with oxygen in a blowpipe consist of carbon and hydrogen, and therefore their combustion results in the production of water vapor and carbon dioxide; the less the quantity of water vapor produced, the higher will be the flame temperature. It will, therefore, be appreciated that the gas having the highest percentage of carbon will produce the highest flame temperature. Acetylene (C_2H_2) has a higher specific gravity and calorific value than any of the commonly employed fuel gases; it only contains about 7 per cent. of combined hydrogen and is the nearest possible approach to gaseous carbon. Pintsch, Natural, Coal, Blau, Water, and other fuel gases all contain 2 to 50 per cent. free hydrogen and also more hydrogen in combination. This hydrogen burns to water vapor, which, as before stated, has a high specific heat and will absorb heat and lower the flame temperature.

HYDROGEN WELDING

Hydrogen welding is generally employed only in localities where oxygen is produced electrolytically and the hydrogen is a by-product. When oxygen combines with hydrogen at the nozzle of a blowpipe steam is formed. This steam becomes super-heated in the flame and is finally decomposed. This decomposition or dissociation limits the temperature of the oxy-hydrogen flame to about 4000° F. The decomposition of the steam introduces another serious factor, the presence of free oxygen which oxidizes the metal operated upon. This can be overcome only by using a large excess of hydrogen. Only two volumes of hydrogen are required to one volume of oxygen, to form water, but in actual practice when employing an oxy-hydrogen blowpipe, it is found that four to five volumes of hydrogen are required to one volume of oxygen in order to insure a non-oxidizing flame. This in itself will cause the process to be wasteful, as the heat is limited to the amount obtained by combining two volumes of hydrogen with one volume of oxygen. Practice has shown that oxy-hydrogen welding is suitable for thin sheet work only. The temperature of the flame is not sufficiently high to

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permit the welding of thick plates or castings, since the flame has to be applied for so long a period that before the necessary fusion point is reached the metal being operated upon is ruined. For thin-sheet welding the process has certain advantages. The flame is a diffused one and consequently less liable to melt through or pierce the metal, as sometimes occurs when employing the oxy-acetylene flame on thin work; and it is probable that a better-looking and finished job can be made with the oxy-hydrogen flame on thin sheets up to 1/16th thick than by any other process of welding. But the quality of the weld is uncertain and the process is more or less wasteful.

OXY-COAL OR CITY GAS FOR WELDING

Owing to the impurities present the oxy-coal or city gas process cannot be employed on work where the strength of the weld is an important factor. The flame temperature is considerably lower than that of the oxy-hydrogen flame; consequently the process can be employed only on very thin iron or steel sheets or on metals having very low melting points.

OXY-ACETYLENE WELDING

Oxy-acetylene welding was first practiced about thirteen years ago. Previous to that time it had been fully appreciated that wonderful results would be obtained from using oxygen and acetylene in a blowpipe, but it had been found impossible to construct a blowpipe that would consume acetylene at low pressure. Acetylene under pressure then came on the market and the blowpipe difficulty was soon overcome. At a later date, injector blowpipes were produced which permitted a low-pressure acetylene being employed. Experience has proved that the best results are obtained when acetylene is delivered at the burner tip under considerable pressure. Today it is usual to obtain acetylene from a pressure generator or from a cylinder of dissolved acetylene, with any type of blowpipe, or to use an injector-type blowpipe drawing the acetylene from a low-pressure apparatus with excess of pressure on the oxygen supply to provide power to suck in the acetylene and deliver the mixture of gas to the blowpipe nozzle at a suitable pressure. However, there is no doubt whatever that in order to obtain economy and really satisfactory working, both gases should be delivered to the blowpipe under pressure. One volume of acetylene (C_2H_2) requires theoretically 2½ volumes of oxygen to burn it completely to its products of combustion, which are carbon dioxide and steam; but in actual practice it is found that 1.1 or 1.5 volumes of oxygen only have to be supplied to the blowpipe to 1 volume of acetylene, depending upon the nature of the acetylene supply and the blowpipe employed. All of you have probably seen an oxy-acetylene blowpipe in operation and know the appearance of the flame, which consists of a small white jet at the nozzle of the blowpipe, surrounded by a blue flame. Acetylene is an endothermic gas and immediately on issuing from the nozzle of the blowpipe dissociates or splits up into its two constituents, carbon and hydrogen. The carbon burns with the oxygen supplied through the blowpipe to form CO, producing the white flame

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at the nozzle. In order to form CO, equal volumes of acetylene and oxygen are required, but then another phase of combustion takes place; the CO burns to CO_2 and the hydrogen later combines with oxygen to form steam. If a blowpipe could supply an absolutely perfect mixture of equal volumes of acetylene and oxygen at its nozzle, the remainder of the oxygen required to burn the CO to CO_2, and the hydrogen to steam, could be extracted from the air. This has not yet been quite attained and in practice some of the oxygen required to burn the CO to CO_2, has to be supplied through the blowpipe, although as stated above, the best blowpipes produced today require only 1.1 volumes of oxygen to one volume of acetylene. It should be understood that the hydrogen combines with the oxygen of the atmosphere only after it has passed away from the high temperature zone of the white welding flame, the temperature of which is about 6000° F., at which figure it is impossible for steam to exist, as it is far beyond its dissociation temperature. The result is that the molten metal is surrounded by free hydrogen, tending to prevent oxidation, the hydrogen also protecting the inner, or welding, flame from loss of heat.

OXY-ACETYLENE WELDING EQUIPMENT

There are today in the field two styles of welding outfits, commonly known as the high- and low-pressure systems. With the low-pressure system the acetylene is supplied from an acetylene generator which delivers gas to the blowpipe at a pressure of two or three ounces, and the oxygen is supplied under pressure in an ordinary trade cylinder. The low pressure of the acetylene supply necessitates the employment of blowpipes of the true injector type, in which excess pressure has to be used on the oxygen supply in order to suck in sufficient acetylene and deliver the mixture of gases at the blowpipe nozzles at a proper pressure. With this method it is more or less impossible to get perfect mixtures of the gases, and the oxygen consumption is undoubtedly higher than when both gases are supplied under pressure. A certain unsteadiness of the flame also has to be contended with. Notwithstanding its drawbacks the low-pressure generator system has one important point in its favor as compared with the high-pressure generator system, namely, that the insurance companies look upon it with much less disfavor.

The high-pressure system of oxy-acetylene welding may be sub-divided into two classes: first, the plants in which the acetylene supply is obtained from a generator which delivers and generates the acetylene gas under pressure; second, those plants which employ cylinders of dissolved acetylene instead of the high-pressure generator. With both these styles of plants, any type of blowpipe can be employed, and, as both gases can be delivered to the blowpipe under pressure, a nearly perfect mixture of gas can be delivered to the blowpipe nozzle, which is not the case when the oxygen only is delivered to the blowpipe under pressure, as in the low-pressure system. High-pressure acetylene generators are looked upon with disfavor by all insurance companies, and in some cities their use is prohibited by the authorities on account of the many accidents which

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have occurred through their employment. They are, as a rule, designed to deliver the gas at a pressure not exceeding 15 lbs. to the square inch. Under this pressure acetylene, if it has no air mixed with it, is not explosive, but at times the class of generators under consideration get out of order, excess pressure frequently being the result. At 30 lbs. pressure acetylene is explosive, and between 15 and 30 lbs. its action is somewhat uncertain.

Where dissolved acetylene is employed instead of a high-pressure generator, immunity in respect to accident due to excess pressure is obtained, due to the fact that the acetylene while under pressure is stored in a porous mass contained in the cylinders, which makes it quite impossible to propagate an explosion through it. Acetylene, when delivered from the generators always contains a small percentage of impurities which are, as a rule, ammonia, sulphuretted and phosphoretted hydrogen. These can be eliminated from the gas if proper purifying apparatus is installed with the plant, but this is very seldom done, with result that the gas delivered from the high-pressure generators always contain a small percentage of the impurities mentioned above. Any one familiar with the working of iron and steel will appreciate fully what will occur if molten iron or steel is brought into contact with the gas containing phosphoretted and sulphuretted hydrogen. When dissolved acetylene, however, is used, instead of a generator, this possibility is overcome, due to the fact that manufacturers of dissolved acetylene always wash, dry and purify their gas before compressing it into cylinders.

Many tests have been made to find what effect the presence of phosphoretted and sulphuretted hydrogen has on a weld. A number of gasoline and gas containers were welded, some with unpurified gas drawn from an acetylene generator, and others with gas drawn from a cylinder of dissolved acetylene. All the welded vessels were tested under pressure, and it was always found that those welded with the unpurified gas did not survive as well under the test as did the others. It may also be noted that when impure acetylene is used the welding flame is colored and much more difficult to regulate.

Users of acetylene generators are apt at times to overload them, with the result that there is undue heating. This heating may cause polymerization, or breaking up, of the acetylene itself. The presence of this altered gas in the pure acetylene will cause changes in the welding flame which affect very seriously the work and necessitate the use of more oxygen than if the acetylene were in a pure state. A cylinder of oxygen and a cylinder of acetylene can be moved readily on a truck to any position in a shop desired, whereas an acetylene generator should be stationary, although there are today on the market various acetylene generators which are stated to be portable. These, however, are not really suitable for welding work, as they are too small to generate gas fast enough to feed the blowpipes without undue heating, which, as mentioned above, is not only dangerous but deleterious to the acetylene itself.

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OXYGEN

Very few users of the oxy-acetylene process manufacture their own oxygen, but purchase it from the large oxygen manufacturers. For commercial purposes oxygen is manufactured by either the liquid air or the electrolytic process and can be obtained in a state of comparative purity from either class of plant. Any impurity contained in oxygen manufactured by the liquid air process is mainly nitrogen, and while freedom from nitrogen is desirable a slight percentage is not fatal to good welding of iron and steel. However, should the percentage of impurities exceed 1½ per cent., the welds will be somewhat porous, due to the absorption of the nitrogen by the molten metal. The purest possible oxygen should, however, be procured for welding aluminum, copper and brass, as at high temperature these metals have a strong affinity for nitrogen. Any impurity in oxygen made by the electrolytic process will be hydrogen; excess quantities will reduce the flame temperature and of course necessitate the use of more oxygen in the blowpipe. Electrolytic oxygen, however, is generally supplied in a comparatively pure state.

STRENGTH OF WELD

The strength of a weld produced by the oxy-acetylene flame is, as a rule, less than that of the original metal unless certain precautions are observed. This can easily be accounted for. It is rarely possible to obtain for filling-in purpose rods of similar material to that being operated on. It is common practice to use rods of high-grade Norway iron for filling-in. This permits of a sound, soft, homogeneous joint being made, but Norway iron has a low tensile strength as compared with the irons and steels of commerce that have to be operated on. This naturally weakens the weld as regards tensile strength. Tests have been given out from time to time which tended to show that steel plates up to ⅝″ in thickness could be autogenously welded and that the weld was stronger than the original plate. This is impossible unless the material used for filling-in be of higher grade than the plate itself. A claim of 100 per cent. weld strength is unsupportable. Practice has shown that with thin steel sheets, say, ⅛″ thick, one can get a weld strength of 95 per cent., and that this figure falls to 85 per cent. for 1″ thick plates. However, in most cases where welding has to be carried out there is no objection to adding a fillet of metal along the joint or using special high-tensile-strength steel for filling-in, when the welded portion can be made to equal or exceed the strength of the rest of the work.

SKILL NECESSARY

Satisfactory results will never be obtained unless skilled workmen are employed to operate the blowpipes. It does not take very long for an intelligent workman to become a fair welder on straight-ahead work on steel plates and similar classes of work which does not exceed ⅜″ in thickness. To weld metals under ⅛″ thick requires considerable skill,

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which practice alone can produce. It takes considerable time for a beginner to attain the necessary steadiness of hand to make a neat weld and avoid piercing the plates. On this class of work buckling difficulties also have to be contended with, but experience soon shows how to overcome them.

To weld work over 3/8" thick takes very considerable skill, and honesty on the part of the operator is indispensable. It is impossible to judge the quality of a weld by merely examining the work after completion—it may have a good appearance and yet be poor work; that is to say, if the plate were fractured at the weld it might be found that the proper fusion had not taken place right through the section and a proper homogeneous mass produced. The skill necessary to undertake this class of work should be attained after a few weeks' practice. Men employed on it should never be hurried; otherwise poor work will result. Piece-work should never be considered under any circumstance. Welding on thick plates is as a rule connected with the work of importance; a faulty weld may have serious results; consequently unless the workman can be trusted, careful watching during the welding process is essential, as that is the only time when the bad work can be detected. Anyone watching the welding process for the first time comes to the conclusion that the operation is very simple and that any workman can operate the blowpipe with little or no practice. This has been a somewhat serious handicap to the industry, as enthusiasts after seeing the process have purchased an equipment and then without any preliminary practice attempted to use it on work of some importance; of course, failure has been the result in most cases and the blame been laid not to the operator but to the process. Oxy-acetylene welding must be considered a trade; a skilled welder is just as much of an artisan as the ordinary blacksmith. This has been appreciated fully in Europe, where welding schools are located at all important centers, and men are thoroughly instructed in the process; after leaving the schools they are placed out on probation in shops where the process is in general use; if, after a period, they have attained the necessary skill, they are granted a certificate. Manufacturers will rarely employ a man for welding work who does not hold a certificate from one of the schools.

PREPARATION OF WORK

One of the chief points to be borne in mind, if oxy-acetylene welding is to be carried out successfully, is that very careful preparation of the work is necessary. The parts to be welded must be free from rust and grease. When making butt or end-to-end welds on plates, it should be certain that the work is cut true. Plates over 1/8" thick must, when a butt joint is desired, be beveled and the opening across the top of the *V* should at least equal the thickness of the plate, so as to make possible the metal being welded throughout the entire thickness of the plate. Plates over 3/4" thick should be beveled if possible on both sides; also welded from both sides. Many workmen will try to weld plates up to 3/8" thick without

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beveling, but a poor joint is invariably the result, mainly due to burning of the metal, caused by too lengthy application of the blowpipe flame. The welding together of plates of different thickness is somewhat difficult, but not by any means impossible; in most cases where this has to be done some special manipulation can be devised to make the job practical.

SPEED

The following table shows the speed at which the welding of steel and iron plates can be carried out; also the necessary acetylene gas consumption:

Thickness of Metal	*Feet Run Per Hr.*	*Acetylene Per Hr.*
In.	Ft.	Cu. Ft.
1/32	30	3.25
1/16	25	5.00
3/32	20	8.25
1/8	15	12.00
3/16	9	18.00
1/4	6	25.00
3/8	4	42.00
1/2	3	60.00

The oxygen consumption will be 1.1 to 1.5 times the acetylene consumption, depending on the quality of the blowpipe employed. As would be expected for metal over ⅜" thick, the gas consumption per foot run of work increases rapidly, and the speed at which the work can be done falls. This leads one to conclude that for constructional work ⅜" metal is about the thickest that should be worked, except in cases where older methods, such as riveting, are impossible. For repair work the case is altogether different; metal of any thickness can be worked, and in almost all cases the repairs effected will be made more quickly, better and more economically than by old methods.

RELIEVING INTERNAL STRAINS

In every case of welding internal strains are inevitably set up, due to the metal expanding when heated and contracting when cooling. When the parts welded form part of a structure and are restrained during the welding process, the strains produced may cause cracking of the metal, especially in the case of cast iron; and the tendency to crack will be greatly increased if the cooling of the metal, after fusion, is rapid or irregular. Whenever local strains exceed the strength of the metal, a fracture must occur. In order to relieve welded metal from internal strains due to welding, it is desirable to preheat the whole work (before welding) and also to reheat it after the welding is completed. In the case of cast iron in a restrained part of a structure this treatment is imperative; the heating should be carried on slowly and the work kept free from air-drafts. This treatment is less essential for steel but can never be anything but beneficial.

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WELDING CAST IRON

To one not acquainted with the process, the welding of cast iron appears to be more difficult to accomplish than work in steel or wrought iron, but such is not the case. Carbon exists in cast iron, in different states; in what is called white iron, which is very hard, the carbon is combined with or dissolved in the iron, but in gray iron, which is soft and easy to work, most of the carbon is in a free state in the form of graphite. Since it is generally necessary to work a weld in cast iron, it is indispensable that the line of welding be constituted of gray iron. The obtaining of welds of gray iron depends on the state of the carbon in the metal. Rapid cooling tends to bring about the combination of the carbon and iron, that is to say, the formation of white iron. Slow cooling or reheating after the welding is completed tends to bring about the precipitation of the carbon and the production of a softer material. It is found that by employing silicon in the filling-rod in the form of ferrosilicon, the iron combines with the silicon in preference to the carbon and allows the carbon to take the form of graphite and thus facilitate the formation of gray iron. The presence of manganese has exactly the opposite effect. It will be seen that in order to get good workable welds there must be slow cooling after the welding is completed. The filling-rod must contain a percentage of silicon, and there must be no manganese present.

The welding point of ordinary cast iron is lower than that of iron or mild steel and lower than the melting point of iron oxide; therefore, if any oxides are formed during the welding process they cannot be melted and blown away by the flame as is the case where iron or steel is fused, when this can be done due to the fact that the melting point of the steel is higher than that of the oxide. It will, therefore, be seen that when welding cast iron it is necessary to employ some flux to break down any oxides formed. When working on thick cast iron the parts to be joined should be beveled as for steel.

Cast iron is a comparatively poor heat conductor, and has no elasticity or elongation before rupture. It is, therefore, necessary to appreciate that when welding it expansion and contraction may bring about breaks if the parts oppose free play of the metal and special precaution must be taken to prevent this. When the size of the piece to be welded allows complete preheating of the whole, and slow cooling, breaks or cracks are not to be feared; but with large castings where total preheating is impossible the welder must exercise thought as to how he can overcome the effects of expansion and contraction by heating other parts of the piece away from the weld.

MALLEABLE IRON

The welding of malleable iron is a somewhat difficult and uncertain operation. Malleable castings are supposed to be of the same texture throughout, but in some cases consist of a core of cast iron surrounded by a layer of iron. It will be appreciated that between the surface of the casting which is nearly free from carbon and the core which is cast iron, there exists a more or less carbonized zone. In some cases where castings

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have thin parts which are properly decarbonized and the fracture is in the thin part, the welding can be carried out just the same as in mild steel. In the thick part of a casting, however, it is different, as the metals of the core and the surface are not the same and require altogether different treatment.

ALUMINUM

The welding of aluminum by the oxy-acetylene process provides an enormous field. Those attempting the work for the first time are apt to be discouraged by their failure, which is common until a few little points have been mastered. The melting point of pure aluminum is about 650° C. and the metal is very fragile in the near neighborhood of this temperature. It is the low melting point combined with high conductivity and specific heat that makes welding difficult for the beginner. The high melting point of the oxide (alumina) as compared with that of the metal itself has to be contended with also. To insure good welds the work must be absolutely clean. To remove all traces of oil from an old aluminum casting takes considerable time; this is best done by heating slowly over a charcoal fire and carefully wiping the oil away as it exudes from the metal. The welding or filling-rod employed on pure aluminum, must also be quite pure, as the introduction of foreign elements may bring about disintegration along the line of welds. The low melting point of the metal necessitates skilful manipulation of the blowpipe, although a hot and fairly large flame is necessary on account of the high conductivity. The oxide formed during fusion does not necessarily rise to the surface as it is denser than the metal; it is therefore essential to use a proper flux. It might seem that deformation of castings due to expansion would be difficult to overcome, but such is not the case in practice as the high conductivity of the metal tends to distribute the heat over the whole mass. When preheating a casting before welding, care should be taken not to raise the temperature to over 500° C.; otherwise it may deform under its own weight. The welding of aluminum alloys, particularly aluminum zinc, is more important than the welding of the pure metal, as most castings are made of this alloy. The percentage of zinc varies as a rule from 10 to 30 per cent.; and copper is generally present in small quantities. It is impossible to know the composition of all aluminum alloy castings that come along for repairs; therefore it is necessary to use a filling material that will be generally serviceable. Rods made up of 88 per cent. aluminum, 10 per cent. zinc, 2 per cent. copper, give good results. Aluminum alloys are not very ductile; hence trouble from expansion and contraction must be guarded against. Some castings have ribs which tend to produce cracks during cooling and in some cases it may be necessary to cut the ribs to allow for the necessary expansion and contraction. These can easily be welded up later.

COPPER

Until quite recently the successful welding of copper was considered impossible, but this was due to the fact that welders were ignorant of the disturbing factors which contributed to poor results and took no steps to

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counteract them. It is easy to make a joint that has the appearance of a good weld but a full knowledge of the nature of the metal and how it should be treated is required before welds can be made that not merely look good but prove under test to be as strong and malleable as any high-grade copper. To obtain good results special filling-in rods must be used; the best results are obtained with phosphor-copper rods which are specially manufactured for welding work. It must not be thought that any phosphor-copper is suitable; the amount of phosphorus must be just enough to do the work required of it and no more. A good flux to employ when welding copper consists of a mixture of salt, borax and boric acid, but should be used sparingly. After welding the work should be reheated and hammered along the weld, again reheated and if possible plunged in water. Copper when heated radiates its heat very rapidly and as it is also an exceptionally good conductor of heat it is found that the heat of the blowpipe alone when dealing with large masses of copper is not sufficient to keep up the fusion; therefore additional heat supply should be provided and as much of the work as possible covered with asbestos to prevent radiation. The employment of phosphor-copper as a filling-rod prevents the formation of copper oxide, which in excessive quantities renders a weld extremely fragile and weak, although a small quantity of this oxide is not detrimental and is considered by some to improve the quality of the metal. Molten copper will dissolve hydrogen and carbon monoxide in considerable quantities and when the metal solidifies the gases are evolved. This causes a frothing of the metal during solidification, the resulting metal being spongy. Unfortunately the gases present in the blowpipe flame are those on which copper exerts its solvent property, but the use of phosphor-copper prevents this, the phosphorus either suppressing their solution or aiding their evolution before the metal solidifies. Copper has a high coefficient of expansion; the consequence is that in cooling considerable stresses may be set up due to contraction, and as copper has very low tensile strength these unless counteracted may cause fractures; but precaution can be taken to prevent this and as a rule the contraction stresses can be nullified by opposing them by means of local heating applied to certain parts, dependent on the shape of the article, or by proceeding with the welding on a certain plan.

BRASS

The welding of brass is quite simple although it would appear at first sight that evaporation of the zinc would be detrimental. This difficulty is overcome by the employment of special welding rods containing a small percentage of aluminum. A good flux to employ when welding brass consists of a mixture of sodium-chloride, borax, and boracic acid. Hammering of brass after welding considerably improves the metal. It should be done cold on brass with a high percentage of copper, and hot on brass with a low percentage of copper. After cold hammering the brass should be annealed.

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BRONZE

The welding of bronze requires that the welding flame be quite neutral. Special welding rods have to be used, containing a percentage of phosphorus in proportion to the nature of the bronze. A similar flux to that employed in brass may be used. Annealing after welding is essential. Tempering may also be resorted to if desired.

METAL CUTTING

It is probably not out of place to refer to the development of metal-cutting by means of oxygen. The blowpipe used for cutting metals by oxygen generally consists of an oxy-acetylene blowpipe fitted with a central of following jet for oxygen only. The work that has to be cut is first of all heated up by means of the oxy-acetylene jet, and, as soon as it is raised to a temperature at which oxygen will ignite it, the separate oxygen jet is turned on, and the metal at once burns away very rapidly. The oxygen supply has sufficient pressure behind it to blow away the oxide as it is formed, with the result that a clean narrow cut can be made through plates up to 12″ in thickness and over. The speed at which this work can be done is high, varying from 100′ per hour for metal ¼″ thick to 12′ per hour for metal 12″ thick; the oxygen consumed in this process varying from 0.50 cu. ft. per foot run in ¼″ plates to 50 cu. ft. in 12″ plates. The users of the oxy-acetylene welding process find it most advantageous to have oxygen-cutting blowpipes in conjunction with their plants. They are found most useful in preparing work which has to be autogenously welded, more particularly in opening out cracks.

MISCELLANEOUS APPLICATION

It will be appreciated that the applications of autogenous welding are innumerable when it is considered that it is possible to weld practically almost any commercial metal without in any way seriously altering its nature, and to add at will any metal to any piece of work. The following are some of the applications to which the process is put today:

Repairs to all classes of boilers in place, such as building up wasted landings and corrosion, repairing cracks in flues and patching same.

Repairing cracked or broken castings of any metal. Making good castings that come from the sand with blow- or sand-holes.

It replaces brazing on cycle frames, forks, and wheel rims. The manufacture of small steel boats; substituting riveting.

Manufacture of safes.

Castings impossible to mold can be made in parts and united.

Artistic ironwork.

Railway steel car construction and repairs.

Building up parts worn by friction.

Pipe jointing.

Repairs to locomotive frames, cylinders, boilers, etc.

Manufacture of steel barrels.

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Manufacture of air and gas containers.
Filling up holes drilled in error.

IN THE AUTOMOBILE FIELD

In the automobile field the savings that can be effected by the process are enormous. This industry provides welding with an unique field. The process already has a firm footing in most shops and is generally employed for repairing cracked cylinders, gear-cases, building up teeth on gears, repairing and reinforcing broken frames, constructing exhaust manifolds, etc. As the process becomes more developed there is no doubt that it will be employed in the construction of motor cylinders built up from sheet iron parts welded together, especially in the case of aeroplane engines where light weight is an essential feature. It is also probable that this form of construction will eventually replace castings for gear-cases, housings, etc.

The oxy-acetylene flame is now employed extensively for hardening the wearing surfaces of steel parts; it is applicable to such purposes as the hardening of the surfaces of gear teeth, template holes and in general to the local hardening of any small area upon a large piece, especially where case-hardening might cause distortion which it would be difficult to remove by grinding. The feature of the process is the quick transit of an intensely hot flame over the surface to be treated, so that it is raised in one continuous wave to hardening heat, and then as rapidly cooled as soon as the flame has passed, by the coolness of the remaining metal, leaving the surface at the maximum hardness the composition of the steel will allow. The hardening will be found to penetrate to a depth of about 1-16".

In the tool room the process is found of great service, especially in the construction and alteration of jigs, and economy in the use of high-speed steel can be effected by welding short pieces to lengths of inferior steel.

DISCUSSION

W. G. WALL:—I would like to ask what relation in welding steel the amount of carbon in the steel bears to the weld; in other words, whether in the case of high-carbon steel it is possible to leave the same amount of carbon in the weld as is contained in the two pieces being welded?

H. SIDNEY SMITH:—This can be effected by using special material for filling in. It is possible today to procure from firms who make a specialty of these materials filling-in metals which contain any desired quantity of carbon. When steel is welded by the oxy-acetylene process there is as a rule a slight loss in the percentage of carbon in the welded joint, but this can be overcome by using a special filling-rod.

CHAIRMAN COMBS:—In other words, you would have to get a filling-rod of higher carbon than the steel to be welded, in order to have the net result the same amount of carbon in the weld as in the steel welded.

H. SIDNEY SMITH:—With oxy-acetylene it is possible to have a car-

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bonizing or oxidizing flame. It is, therefore, possible by using excess acetylene to add carbon to the metal operated upon.

SECRETARY GRIMES:—Can you weld a high-copper brass to a low-copper brass?

H. SIDNEY SMITH:—Yes, provided a proper filling-in material is employed.

F. E. MOSKOVICS:—Have you had any experience in the practice of adding sheet metal in cylinder work? I saw a motor of which practically the entire cylinder construction was sheet metal autogenously welded.

H. SIDNEY SMITH:—I have had no actual experience in that myself but I have seen such welding carried on in Paris. There that construction of aeroplane motors is quite common.

CHANGES OF ADDRESS OF S. A. E. MEMBERS

Cornell, Fred. A., formerly general manager Apple Electric Co., Dayton, Ohio, now with Mitchell-Lewis Motor Co., Racine, Wis.

DeOrlow, Stephen O., formerly experimental designer, Packard Motor Car Co., Detroit, Mich., now in engineering department, International Harvester Corp., Akron, Ohio.

Evans, W. F., formerly with Houk Mfg. Co., Buffalo, N. Y., now with Standard Screw Products Co., Detroit, Mich.

Green, Leslie H., formerly sales manager, Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., now sales manager, Detroit Foundry Co., Detroit, Mich.

Herreshoff, Charles F., formerly vice-president and chief engineer, Herreshoff Motor Car Co., Detroit, Mich., now president Herreshoff Light Car Co., Troy, N. Y.

Kerr, Maurice L., formerly assistant engineer, Crown Commercial Car Co., N. Milwaukee, Wis., now engineer, Dart Motor Truck Co., Waterloo, Iowa.

Knight, W. C., formerly salesman and local engineer, Stewart-Warner Corporation, Detroit, Mich., now western sales manager, Boston Auto Gage Co., Detroit, Mich.

Lunn, Ernest, formerly president, Walker Vehicle Co., Chicago, Ill., now chief electrician, Pullman Co., Chicago, Ill.

Pope, Chas. S., formerly engineer, Spaulding Manufacturing Co., Grinnell, Iowa, now with Harland & Pitka, Tama, Iowa.

Pope, Harold L., formerly mechanical engineer, Pope Mfg. Company, Hartford, Conn., now with Ferro Machine & Foundry Co., Cleveland, Ohio.

Teetor, D. C., formerly engineer, Staver Carriage Co., Chicago, Ill., now with Teetor-Harley Motor Co., Hagerstown, Md.

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APPLICATIONS FOR MEMBERSHIP

A list of current applications for membership received is given below. The members are urged to send for the consideration of the Council, which under the revised Constitution has jurisdiction of the election as well as the grading of applicants for membership, any pertinent information with regard to those whose names are given which the Council should have prior to the election of any of the said applicants. It is requested that communications from the members in this connection should be sent promptly.

Anderson, Robert M., Professor, Department of Engineering Practice, Stevens Institute of Technology, Hoboken, N. J.

Bull, Arthur A., automobile engineer, Cadillac Motor Car Co., Detroit, Mich.

Clarke, Alex. Fielder, works manager, Firth-Sterling Steel Co., McKeesport, Pa.

Dick, Robert I., service manager, Dart Motor Truck Co., Waterloo, Ia.

Frewen, Thomas F., designing draftsman, Alex. J. Botts, Pittsburgh, Pa.

Lane, Theo. T., production and service engineer, Wichita Falls Motor Co., Wichita Falls, Tex.

Langston, Chas. R., manager, Kansas City Branch, Kelly-Springfield Motor Truck Co., Kansas City, Mo.

Martin, Frank H., Eastern sales manager, Stewart-Warner Speedometer Corp., New York City.

Massey, Hemsley B., draftsman, Franklin Mfg. Co., Syracuse, N. Y.

Menderson, Edgar, laboratory engineer, Dodge Bros., Detroit, Mich.

Moore, Edgar E., chief engineer, American Electric Co., Saginaw, Mich.

Moore, M. L., sales manager, American Developing & Sales Co., Stamford, Conn.

Murfey, S. L. Michigan representative, Grant-Lees Gear Co., Cleveland, Ohio.

Page, Victor W., experimental engineer and manager, Department of Tests, New Departure Mfg. Co., Bristol, Conn.

Parker, Willard, vice-president and general manager, Pennsylvania Shafting Co., Spring City, Pa.

Raseley, H. A., service manager, General Motors Export Co., Sydney, N. S. W., Australia.

Russel, P. S., manager, Philadelphia Branch, Buick Motor Co., Philadelphia, Pa.

Sackman, William H., superintendent, Lycoming Foundry & Machine Co., Williamsport, Pa.

Taylor, Wm., designer, Chalmers Motor Co., Detroit, Mich.

Woodbury, A. C., assistant editor, *The Horseless Age,* New York City.

Wright, Mortimer Hamilton, mechanical superintendent, Pennsylvania Shafting Co., Spring City, Pa.

Young, O. W., designer, H. E. Wilcox Motor Co., Minneapolis, Minn.

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ANNOUNCEMENT

BEGINNING with the October number of the BULLETIN a limited amount of space will be devoted to advertising.

It is the purpose to confine the advertising section mainly to announcements of manufacturers of parts, materials and accessories for automobiles. These will be set forth in a manner in keeping with the aims and purposes of the BULLETIN, and will be of obvious value and interest to its readers.

Any information as to the service will be furnished on request.

Society of Automobile Engineers
1790 Broadway, New York City

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MEMBERS ELECTED OCTOBER 1st

MEMBERS

Adams, Charles E., Cleveland Hardware Co., Cleveland, Ohio.
Bliss, Harold N., 4 Elm Street, Jamaica Plain, Mass.
Bott, Geo. R., Norma Company of America, 1790 Broadway, New York City.
Caldwell, E. DeH., Empire Axle Company, Dunkirk, N. Y.
Cunningham, Richard H., 60 West 10th St., New York City.
Daniels, George E., 24 Jackson St., Cape May, N. J.
Gildner, H. H., S. K. F. Ball Bearing Co., 50 Church St., New York City.
Grant, Chas. H., Page Fence Co., Adrian, Mich.
Halbfass, Arnold J., General Vehicle Co., Long Island City, N. Y.
Hart, William J., 544 East 3rd St., Mt. Vernon, N. Y.
Hawley, Wm. G., American LaFrance Fire Engine Co., Elmira, N. Y.
Lee, Thomas L., North East Electric Co., Rochester, N. Y.
Mann, Howard L., Box 277, Chicago Heights, Ill.
Parker, Clark W., 139 Elmhurst Ave., Detroit, Mich.
Schaeffer, Henry, 2500 Cottage Grove Ave., Chicago, Ill.
Winckler, Aage E., Box 173, Racine, Wis.

ASSOCIATES

Alms, W. E., Findeisen & Kropf Manufacturing Company, Chicago, Ill.
Bouggy, Clifford M., J. S. Bretz Company, 250 West 54th St., New York City.
Curtiss, Carlos W., Splitdorf Electrical Co., 98 Warren St., Newark, N. J.
Dorman, A. D., 564 W. Monroe St., Chicago, Ill.
George, I. A., 17 Park Terrace, Hamilton, Ohio.
Kemp, Wm. E., 1733 Broadway, New York City.
Middleton, Ray Trago, Electric Welding Products Co., Cleveland, O.
Murray, C. E., Willard Storage Battery Co., Cleveland, O.
Oberly, Howard E., 2558 West 16th St., Chicago, Ill.
Owen, Raymond M., 735 Seventh Ave., New York City.
Ralph, W. I., *Class Journal Company*, 239 West 39th St., New York City.
Stevens, C. T., Reinhard Bros. Company, Minneapolis, Minn.
Swartley, Wilmer C., Tioga Steel & Iron Co., Philadelphia, Pa.
VanSyckel, C. S., Huston Multiple Spring Co., Philadelphia, Pa.
Young, Conrad H., Armstrong Cork Company, Philadelphia, Pa.

JUNIORS

Lathrop, Thomas L., Buick Motor Company, Flint, Mich.
Moffat, Alex. W., 11 Cedar Court, Flushing, L. I.

MEN AVAILABLE

0272. Engineer and purchasing agent, with eight years' experience in light pleasure car and all capacities of commercial car designing, is open for engagement. Can furnish first-class references.

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0273. Young man of 25, with four years' experience on the editorial staffs of automobile trade papers is at the disposal of an advertising manager. Would be glad to submit advertisements that he wrote while doing editorial work. Not a "know-it-all" and is willing to start for a fair living salary.

0274. Graduate mechanical engineer with fifteen years' experience in engineering and production departments of motor vehicles and accessory manufacturers, available for position soon; now engaged.

0275. Man with seven years' drafting experience on pleasure cars and electric starter work wishes to take charge or assist in establishing a drafting room system which turns out excellent drawing in minimum time.

0276. Service manager or engineer with excellent executive and engineering ability. Experienced in truck and pleasure car manufacture, design, repair and shop practice. Wide mechanical experience. Used to handling men and assuming responsibility. Good correspondent. Married. Age thirty-four. Western location preferred.

0277. Engineer, mechanical and electrical. Capable and energetic, with excellent executive ability. Exceptionally good practical experience on both trucks and pleasure cars in engineering, designing, purchasing, shop practice, construction and production. Especially competent on electric systems. Able to handle men and fully capable of assuming responsibility. Married. Age thirty-three. Salary moderate.

0278. Salesman with electrical and mechanical engineering experience; for the past four years selling an accessory to the motor manufacturers in the United States, Canada and Europe.

0279. Pioneer automobile engineer and executive who has a very wide and accurate knowledge of pleasure car and truck engineering and business conditions in this country and abroad, would consider engagement on a basis commensurate with his previous work and success. Development work in the East preferred.

0280. Engine designer, competent to take charge of drafting room, design of complete car or experimental work. Ten years' experience.

0281. Chief engineer of prominent motor truck company, having just completed designs for full line of latest type trucks, is open for engagement.

0282. Chief engineer and designer in buildings, transportation, tools and construction. Long and valuable experience. Has specialized in indoor (warehouse) trucks.

0283. Production superintendent or assistant engineer; man who can design in consideration of present-day quantity production requirements and produce quantities at reduced cost.

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0284. Engineer and designer; seventeen years' European experience on all classes of vehicles, from light pleasure cars to heavy trucks, tractors and gasoline rail cars. Has studied necessities of design, from extensive road and repair department experience. Would consider sales or service end of business.

0285. Draftsman of executive ability with seven years' broad experience in the automobile line as layout man, designer and chief draftsman. Especially good on economical production. American, thirty years of age.

0286. Young man with four years' .practical experience with motor car manufacturers. At present employed as designer and chief engineer. Desires position with large manufacturer. Has held positions in office, purchasing, drafting, laboratories and engineering departments.

0287. Engineer just returned from England desires position as engineer, chief draftsman or designing engineer. Ten years' experience.

0288. Young man, twenty-seven, eleven years' experience with foreign and American high-class cars. Expert on all classes of work. Excellent producer. Wishes to locate with progressive concern manufacturing either pleasure or commercial cars.

POSITIONS AVAILABLE

The following announcements are published for the information of members of the Society. No charge whatever is made for these announcements. Members who wish additional information will please address the office of the Society:

123. Production manager or production superintendent. Man who can reduce costs and get out quantities.

127. Salesman for heavy trucks on a commission basis. Not necessary to give entire time.

*135. Sales manager, salary and commission to be agreed upon.

142. Young man familiar with machine design. Experience on presses and shears preferred. Salary dependent on experience.

*147 Sales manager, experienced, on commercial work, and in a position to invest $2,000. Exceptional opportunity.

*158. Draftsmen, with experience in designing small motors or generators for automobiles. For factory manufacturing small interchangeable parts for electrical apparatus. Only those having had at least three to four years' experience need apply. Salary $18 to $22.

---

*Send written application to S. A. E. office to be forwarded to employer.

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*167. Salesman, one that is capable of managing sales department, familiar with the automobile trade and of pleasing personality.

169. A high-grade retail salesman of moderate-priced pleasure cars for New York City proper.

174. Engineer or experienced man capable of designing attachment parts for shock absorber.

176. Inspector on automobile parts. Must be A1 man.

*179. Expert final chassis tester and motor expert, on commercial work.

181. Technical graduate of two or three years' experience, preferably in production end of automobile manufacture, for office work in sales and order department of parts manufacturer; leading to sales engineer.

184. Experienced automobile draftsman—resident of New York City preferred.

*185. Wanted by one of the largest automobile accessory manufacturers, a first-class man on die castings (especially die-cast aluminum) to organize a separate department. This is an opportunity for a man who is no has-been or experimenter. Give full particulars in first letter or no notice taken.

189. Foundry foreman; one who can handle men and knows foundry business, especially in the cast-iron line.

190. Experienced production man for a light four-cylinder car.

*194. A well educated man for a position on the editorial staff of a leading motor vehicle trade journal. Must be a clear thinker, a good, easy writer with a keen appreciation of journalistic values. Must have a knowledge of finance, industry, transportation and economics. Engineering talent or at least an acquaintance with motor vehicle design and construction, is essential. Must be willing to work under a prearranged editorial policy, able to produce high quality copy on scheduled time, and must know printing and engraving.

195. Electrical engineer to take complete charge of electrical end of the automobile, in experimental stage as well as in production.

196. Vacancy for an assistant sales manager. Must be a technical graduate in either mechanical or electrical engineering. One who has been a success as an engineer as well as associated in the sales end of some good live organization. Must be able to satisfy us as to his ability as both a salesman and an engineer. We prefer one who is at present employed with a live wire concern. Salary $3,000 to $4,000.

*Send written application to S. A. E. office to be forwarded to employer.

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OFFICERS OF THE SOCIETY

President, Henry M. Leland, Detroit, Michigan.

Vice-president, William Guy Wall, Indianapolis, Indiana.

Vice-president, K. W. Zimmerschied, Detroit, Michigan.

Treasurer, Hermann F. Cuntz, New York.

Chairman of Finance Committee, H. M. Swetland, New York.

Secretary and General Manager, Coker F. Clarkson, New York.

MEMBERS OF THE COUNCIL

Henry M. Leland, Detroit, Mich.

William Guy Wall, Indianapolis, Ind.

K. W. Zimmerschied, Detroit, Mich.

Hermann F. Cuntz, New York.

Joseph A. Anglada, New York.

Harold L. Pope, Hartford, Conn.

E. F. Russell, Longmeadow, Mass.

Christian Girl, Cleveland, Ohio.

Henry C. Wilson, New York.

Walter C. Baker, Cleveland, Ohio.

H. W. Alden, Detroit, Mich. (Past President).

Howard Marmon, Indianapolis, Ind. (Past President).

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SECTIONS OF THE SOCIETY

DETROIT SECTION

E. T. BIRDSALL.....*Chairman*
C. T. MYERS and W. N. OSBURN.....*Vice-Chairmen*
HERBERT L. CONNELL.....*Secretary and Treasurer*

(Address) 109 Webb Avenue, Detroit, Mich.

Meets first Thursday each month at 8 p. m., in the Employers' Association Rooms, Stevens Building, Detroit, Mich.

INDIANA SECTION

LON R. SMITH.....*Chairman*
R. H. COMBS.....*Vice-Chairman*
CHAS. P. GRIMES.....*Secretary-Treasurer*

(Address) Wheeler & Schebler, Indianapolis, Ind.

Meets first Tuesday after first Wednesday each month at 8 p. m., at the Hoosier Motor Club in the Claypool Hotel, Indianapolis, Ind.

METROPOLITAN SECTION

JOSEPH A. ANGLADA.....*Chairman*
HERBERT CHASE.....*Treasurer*
N. B. POPE.....*Secretary*

(Address) 1790 Broadway, New York City.

Meets last Thursday each month, except July and August, 8 p. m., at the Automobile Club of America, 247 West Fifty-fourth Street, New York City.

CLEVELAND SECTION

JAMES H. HERRON.....*Chairman*
H. B. ANDERSON.....*Vice-Chairman*
A. J. SCAIFE.....*Treasurer*
R. J. NIGHTINGALE.....*Secretary*
E. R. HALL, J. H. HERTNER, R. H. MANSON } ..... *Members Board of Directors*

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Members are requested to advise the S. A. E. office promptly of change of address, using form herewith:

SECRETARY,

SOCIETY OF AUTOMOBILE ENGINEERS,

1790 Broadway, New York City.

Please change my address now appearing on your records, to the following:

Company connected with.....

Profession or Position.....

Address of Company.....

Address for Mail.....

Articles Manufactured.....

.....

.....

.....

.....

.....

.....

.....

Very truly yours,

.....

S. A. E. Member.

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FILL OUT AND SEND TO S. A. E. OFFICE

SECRETARY,

SOCIETY OF AUTOMOBILE ENGINEERS,

1790 BROADWAY, NEW YORK CITY.

Please send application blank to

.....

NAME

.....

POSITION AND COMPANY

.....

ADDRESS

whom I consider eligible to S.A.E membership.

.....

S. A. E. MEMBER

.....

ADDRESS

Date.....

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FILL OUT AND SEND TO S. A. E. OFFICE

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1790 BROADWAY, NEW YORK CITY.

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POSITION AND COMPANY

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ADDRESS

whom I consider eligible to S. A. E. membership.

.....

S. A. E. MEMBER

.....

ADDRESS

Date.....

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VOL. VII NO. 1

S.A.E. BULLETIN

OCT. 1914

STANDARDS DISCUSSION
STEEL SPECIFICATIONS
WIRING SYSTEMS
ROLLER BEARING SIZES
RIM TESTS
STOCK TIRE SIZES
FITTING BALL BEARINGS
REVISED BY-LAWS

SOCIETY OF AUTOMOBILE ENGINEERS
1790 BROADWAY, NEW YORK

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S. A. E. Bulletin

VOL. VII OCTOBER, 1914 No. 1

Published by the Society of Automobile Engineers
1790 Broadway, New York
HENRY M. LELAND, President. COKER F. CLARKSON, Secretary.
HERMANN F. CUNTZ, Treasurer.

Issued monthly, 50 cents a number, $5.00 a year; to members 25 cents a number, $2.50 a year. Entered as second-class matter, August 27, 1914, at the post office at New York, New York, under the Act of August 24, 1912.

STANDARDS COMMITTEE CONVENTION

November 17th to 19th

The next Convention of the Standards Committee will be held at the rooms of the Society in New York on November 17, 18, 19. The purpose of the meeting is to provide an opportunity to discuss the various standards and practices under consideration for recommendation, as well as some standards and practices that have been accepted heretofore. It is expected that reports will be made by several of the Divisions of the Standards Committee on a variety of subjects, including:

Stock sizes of roller bearings.
Flanges for side-outlet carbureters.
Thickness of motor truck felloe bands.
Electric vehicle standards.
Industrial truck standards.
Physical properties of S. A. E. steels.
Heat treatment of steels.

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Steel castings specifications.
S. A. E. lock washer standard.
Non-glaring headlights.
Wiring systems for gasoline automobiles.
Scientific tests of gasoline motors.
Horsepower formula data.
Pneumatic tire stock sizes.
Tap drill sizes.
Vehicle taxation formula.
Leaf spring clips.
Bell housings for unit powerplants.
Motor support dimensions.

The Council will hold a meeting at the time of the Convention. Meetings of about a dozen of the Divisions or subcommittees of the Standards Committee will be convened during the three days of the meeting of the whole Committee, the proceedings of which are confined primarily to discussion of Division reports submitted to it.

All members of the Society are, of course, welcome at the Standards Committee meeting.

WINTER MEETING

The 1915 annual meeting of the Society will be held in New York on January 6th and 7th. Professional sessions are scheduled for the morning, afternoon and evening of each of the two days, and will be held in the Engineering Societies Building, which is located at 29 West 39th Street, not far from Grand Central Palace, in which the automobile show will be in progress during the week.

Plans are being made to have the members dine together informally on each of the meeting days.

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IRON AND STEEL DIVISION REPORT *

DISCUSSION AT CAPE MAY

STANDARDS COMMITTEE MEETING

CHAIRMAN SOUTHER:—Vice-president Zimmerschied will present the fifth report of the Iron and Steel Division, inasmuch as in my absence he presided at the last meeting of the Division.

K. W. ZIMMERSCHIED:—The fifth report of the Iron and Steel Division is quite brief as compared with its predecessors, and consists mainly in a revision of the previous report, minor changes in some analyses, and a great many eliminations.

Our original series of analyses covered almost every species and variety of alloy steel which could be demanded by automobile engineers. After the lapse of two years, however, we have found that many of these steels are not commonly used, and that their presence in our list of standard compositions only tends to complicate the situation for many engineers rather than simplify it. The committee has therefore eliminated the analyses of those steels which in its judgment are of least value to the industry as a whole.

IMPURITY CONTENT.

Concerning the increase in sulphur that has been allowed, it should be explained that this has been due to the changes which have come in commercial steel practice today. Under conditions which have been growing on the steel mills for the past five years it is difficult to the point of impossibility to make steel commercially in the open-hearth furnace from commercial raw material and keep it consistently inside our old upper limit of .040 sulphur without being forced to charge an extra price for such material.

With regard to nickel chromium steels, we had a class called "low nickel-chromium," which ran .15 per cent. to .45 per cent. chromium. This amount of chromium has been shown in actual practice to be too little to give an adequate return for the increase in price, so that the higher grade, which has the range of .45 per cent to .75 per cent., has been chosen as standard.

With regard to silico-manganese spring steel, we have had considerable discussion in the Division and in a former Standards Committee meeting as to the desirable limits for sulphur, phosphorus and silicon. We have considered the contention that very stringent limits should be established for these elements, but the Division has ruled, as in so many similar cases, that we should aim to supply a good commercial material as standard, leaving ultra refinements to those whose problems or conditions are such as to warrant or demand such treatment. The recommended analysis is acceptable to all parties save one.

*For text of report see S. A. E. Bulletin for June, 1914.

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CHAIRMAN SOUTHER:—Is there not something we should refer to the Division as new matter? The firm of I. G. Johnson and Company ask that instead of one specification for steel castings we have five or six to cover the whole field. It has been our desire to keep the specifications as simple as possible, but here is a request which we must take up in committee with a good deal of care. Unless there is some objection I would like to let that matter go to the committee before presenting it to the Society as a whole.

Gentlemen, you have heard the report by Mr. Zimmerschied. Are there any phases of it which you care to discuss? Does any one want to find out why we raised the limits of phosphorus and sulphur more definitely than as stated by Mr. Zimmerschied? I will say in explanation that as time goes on the commercial situation changes a little, and further our practical knowledge of the practical effect of differences in elements or metalloids is sometimes quite changed. We know now that with proper heat treatment and proper handling the limits we have set will produce very good motor car parts. The committee has not selected the purest possible steel that can be purchased in the world to recommend as a standard, because if we did prices would be prohibitive. It has chosen a practical limit. The standard does not say that a member cannot specify a lower degree of impurity and therefore a purer steel. Many do. It is quite necessary in some arts. Now that question will have to come up, has come up again and again, not only in this committee and this Society, but in the Society for Testing Materials, in the Institute of Mining Engineers and in one of the associations of steel makers. I would like to have the matter discussed and understood fully by those members present. Are there any remarks? Are you ready for the question?

The question is, shall this report as read by Mr. Zimmerschied and as printed be submitted to the Council for approval and thence to the Society if approved by the Council.

Those in favor signify by saying "aye," those opposed "no." It is a vote.

SOCIETY MEETING.

CHAIRMAN SOUTHER:—The work of the Iron and Steel Division has been continued, the principal object aimed at during the year having been to get together the data necessary for the members to have in order that they may know just what the S. A. E. steels or steels like the S. A. E. steels will do when subjected to various treatments, annealing, quenching and so on. That has been a big undertaking. The method pursued has been to prepare blanks, which, if filled out or partially filled out even, will give the committee the data necessary. We propose to lay before you a series of curves for each grade of steel, so that you can see very clearly and in a very practical manner just what may be expected of each quality of steel under a given treatment, the treatment being specified on the curves, as well as the results obtained. Sample copies of such curves have been laid before you, and the work is well under way.

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Some have stated in reply to requests that they fill out and return the forms that they do not use S. A. E. steels. The facts are that they do not call them S. A. E. steels, but they do use them. That is, the steels are of the same composition, and they used treatments similar to the S. A. E. treatments. That being the case, all they need do is to send in the results they get from certain grades of steel. The Division will judge what use to make of the data.

There must not be any mistaken idea of the kind indicated. S. A. E. steels cover nearly every steel on the map, and if any one uses and treats steel, we can make use of the data obtained. The misconception has caused us a good deal of delay and annoyance.

Other action has come up in the natural course of business. One is the elimination of a large number of specifications for the simple reason that they are found by actual experience to be superfluous. People do not use them, therefore why continue them? When they were first printed it seemed that they might be used, but experience shows that they have not been and that the number of steels is diminishing each year. Consequently some unnecessary steels have been eliminated from the specifications.

Further, the method of naming the steels has been changed very slightly. It was the habit to call a carbon steel 10-20, meaning that it was a carbon steel of 20 carbon. But that is confusing, because many people call steels "10 to 20 carbon." So we will merely drop the dash, and it is 1020, that is, without the dash; practically no change at all in that respect.

One other change has been made, and that is the acceptance of steels .005 per cent. higher in phosphorus and in sulphur than before. The reason is very clear. It is a very practical one and a very commercial one. It is that commercially no better results will be obtained from steels .005 per cent. purer in sulphur and in phosphorus. That prices on the S. A. E. standard steels will not be higher, at least, possibly a little lower, therefore there will be a commercial gain without a practical loss.

There is some feeling, if one can judge by the correspondence and remarks, that when we say that the steel shall contain not more than .045 phosphorus, we expect to get .045 all the time. That is not so at all. What it does mean is that no steel shall be accepted under the specifications that exceeds that limit.

A further complication is introduced by the chemical errors in analyses. Laboratories differ, let us say, in phosphorus determinations, and surely in sulphur determinations, at least .005. If they work within those limits they are doing splendidly. Now when we say .04, as we have in seasons past, the question arises, if steel comes .045, shall we accept it? Personally I have always said yes, unless it comes that way habitually, because I knew that it cut very little figure. The disposition of the committee is that .045 shall be specified and that that limit shall be lived up to strictly. So in reality the apparent lowering of purity is not a fact; it is entirely

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a practical question. Some members seek exceedingly high results and produce goods perhaps considerably above the average; they may find it necessary or desirable to specify .01 phosphorus and .01 sulphur, or .02 phosphorus and .02 sulphur. There is nothing in the S. A. E. specifications that forbids that. That is entirely up to the man purchasing the material.

The question arises at once, is the S. A. E. backing steels that should not be backed, because they are not good steels? The committee believes not, and that belief has been reached after most exhaustive discussion and careful consideration by both consumer and producer.

The question of silico-manganese steels as peculiarly adapted for springs came up, as to whether there should be one, two or three specifications. After considerable correspondence it was decided that the committee should recommend but one, believing that with suitable treatment sufficiently good springs can be made from it.

PRESIDENT LELAND:—Gentlemen, you have heard the report of the Iron and Steel Division. Is there any discussion? What will you do with the report?

HOWARD E. COFFIN:—I move the report be accepted.

(The motion was seconded, put to a vote and carried.)

SINGLE-VERSUS TWO-WIRE SYSTEM

DISCUSSION AT CAPE MAY OF ELECTRICAL EQUIPMENT DIVISION REPORT.*

STANDARDS COMMITTEE MEETING.

JOSEPH BIJUR:—My personal opinion is that the members of the Division are still somewhat divided; that those in favor of two wires would not really object strenuously to the attempt to get together on some standard, and that those who favor the single wire think it would be greatly in the interest of the automobile art to have only one style of fitting made necessary, feeling that having a single wire would permit very much better fitting than with two wires. The standardization of the single-wire system in the comparatively early stage of its use must be more or less a matter of opinion rather than a matter of experience. I think, Mr. Chairman, that is all I can say that will throw any light on that situation.

I might also say as to that portion of the report which deals with the temperature test, that I do not know of any difference of opinion in the Electrical Equipment Division.

*For text of report, see S. A. E. Bulletin for May, 1914.

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CHAIRMAN SOUTHER:—Gentlemen, you have before you a very brief report and a very important one, apparently. One thing we must bear in mind all the time and that is this: Anything we adopt today as recommended practice may not be adopted by the industry at large tomorrow, but may be worked toward in designs in the future. Anything that is recommended today does not have to be carried out tomorrow, so to speak. I think there is a great deal of feeling among the members who have not stopped to think about it very much or who have not been to very many committee meetings, that if a part is to be adopted it has to be adopted today or tomorrow. Nothing of the kind. If it stands in our Data Book and Transactions, it is a suggestion for all to follow if they think it is a good one. If it is not a good one, it will certainly not be followed. If it is a good one it becomes common practice and is then taken as the real standard.

It is recommended in the report that the single-wire system with grounded returns shall be recommended practice.

W. H. CONANT:—Perhaps I can say a word or two that will show you the committee's frame of mind. At the first meeting at which the subject under discussion has come up recently, five of us were present, two of whom represented manufacturers of cars and two makers of electrical equipment. They appeared to be, perhaps not deadlocked, but equally divided in opinion. Most manufacturers of electrical equipment favor the two-wire system. On the other hand, makers of cars seem to prefer the single-wire. I tried very hard to adopt a neutral attitude and that was one reason we did not come to any conclusion at the first mentioned meeting of the Electrical Equipment Division.

At the second meeting there were more present—probably eight or ten members of the Division. We discussed the matter three hours steadily, I think, and the discussion brought out this: that however much some of us seemed to prefer the two-wire system the tendency was very clear; it was evident that the single-wire appeared to be coming. As the Society endeavors to lead or to keep abreast of the very best practice in the industry, it seemed wise to us to make some progress by submitting this report. Mr. Bijur, in presenting it, was very modest. He personally favored the two-wire system, but did not let that color his views in presenting the matter to you. I think he believes in looking beyond the present season, beyond his present preferences or wishes in the matter. We are distinctly trying to see ahead to the best practice of the coming seasons. If we were to recommend *two* wire and certain conditions in the industry seem to call for single wire to an increasing extent every season, the committee would be lagging behind the industry rather than keeping abreast of it and would not be living up to its true functions.

CHAIRMAN SOUTHER:—I judge, Mr. Conant, that nothing fundamentally wrong developed about the single-wire system?

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W. H. CONANT:—We discussed that, Mr. Chairman, from more points of view than I can possibly take time to describe or report. There are distinct electrical advantages in favor of the two-wire system, but we must put them secondary to the automobile as a whole. There are distinct manufacturing advantages so far as the cars are concerned in the single-wire system and it is very hard to oppose those manufacturing advantages. If the electrical manufacturers followed entirely their own inclination, I am inclined to think that a good many two-wire systems would be in use, but electrical manufacturers are in business to supply what motor car manufacturers demand or prefer.

Perhaps I have omitted the most important point. The one feature more than any other that has swung some of us around to the single-wire system is the matter of lamps and receptacles or sockets. With the single-wire system we can obtain better lamps, better contacts and better receptacles. Mechanically one wire is much better. That is the point. Electrically it is not as good, but the mechanical part is so much better taken care of within the space allotted, within the permissible diameters, that we have rather worked back from the lamps to the wiring system.

In the matter of fuses we are all agreed that in the single-wire system they are essential. Mr. Kebler thinks we should not have fuses with the two-wire system, but I think the committee rather overruled him in that matter.

HOWARD E. COFFIN:—I think the tendency is towards the single-wire system. I have discussed this with our people two or three times. It rather always gets back to the question that there are a good many manufacturing advantages in favor of the single-wire system. We all lose sight, perhaps, of some of the electrical advantages in looking at the manufacturing end of it. Further than that, I think either the single-wire or double-wire system may be made a success or a failure by the manner in which the installation is made. Either must be installed properly to get good results.

W. H. PALMER, JR.:—I was impressed by this: the action of the committee was taken from a more or less practical point of view. They felt it was necessary to do something that would guide development, particularly the design of fittings and attachments. We had the two systems, the single-wire and double-wire, using entirely different lamp sockets, and things of that kind, at least suggesting the use of entirely different ones, and the result seemed to be that the manufacturers of such parts were more or less marking time and waiting to see what was going to happen. They did not want to switch over from one to the other exclusively unless they knew that was the thing that was going to be asked for.

What seemed to be necessary was good, consistent work in the perfection of details in the lamp sockets and systems of wiring generally.

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The committee seems to have taken a very careful unbiased view of the situation and convinced themselves beyond any question that the tendency is towards the single wire. I think it is a fact that the largest manufacturers of electric lighting systems, those who are equipping the largest numbers of cars today, have declared in favor of the single-wire system after having gone into the matter very carefully. The Dayton Electrical Laboratories Company, for example, after equipping to date over 125,000 cars, have recently gone over to the single-wire system as a standard. I believe the Gray & Davis Company, another very large manufacturer of equipment, having equipped in the neighborhood of 75,000 cars to date, are also in favor of the single-wire system. In addition we have automobile manufacturers like Mr. Riker, for example, chairman of our Division, who is not only an electrical engineer in training but has been an automobile manufacturer for many years, who has tried both systems, has looked into the matter from every angle, and is very much in favor of the single-wire system.

It is not that the double-wire system is not all right and cannot be made to work, but it is a feeling that we have with respect to all matters that the Standards Committee handles and in connection with which it gives something for recommended practice, that it is better to concentrate efforts on some one line and get somewhere, than it is to carry along a number of things, all of which may be equally good. You can make more progress by recommending practice along one single line, and getting everybody to work on that, than you can by dividing your efforts. On the other hand, as Mr. Souther says, there is nothing in the recommendation that need prevent anyone from using any other construction if he thinks it is better. This matter has been discussed in the committee meetings for two years. We were going around and around a circle, and every time we discussed it we seemed to get nearer to that focal point, and finally we decided it was time for us to stop talking and try to do something; and a motion to recommend the single wire was passed at the last committee meeting without a dissenting vote.

E. E. SWEET:—We favor the single-wire system.

DAVID FERGUSON:—We have been using the single-wire system for two years and are very much in favor of it.

A. D. LIBBY:—It is immaterial to me personally one way or the other whether it is a single-wire system or a two-wire system, so long as the *best* results are obtained, results which are lasting and permanent and will give the best and most lasting satisfaction to the public.

If it is in order, I will mention here an illustration which I have referred to in my paper in which a high-priced car came within the merest chance of getting burned up on account of the one-wire system, because the wire running up to the dash became grounded on the conduit, and there being no protection whatever in that lead the conduit was melted and ran down like lead. It was only by the quickest energetic action of the men who happened to be there at the time that the

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car was saved from being burned up. Now that is only one of a number of instances which I have knowledge of.

I think there is not a question of doubt in the minds of any of us that the two-wire system will do the work perfectly satisfactorily. In addition, it gives the car owner twice as many chances against trouble. In other words, with the one-wire system, wherein the practice has been in the past and is today, to have no protection whatever in the battery lead running to the starting switch and on to the starting motor, a ground at the motor brush, which I have seen occur, will start some trouble. Either the wire is going to burn off at some one of the joints or it is going to injure the battery or start a fire in some place.

With a two-wire system a ground can come on one of the leads and not give any trouble, and a man will not have any trouble unless he should happen to get a ground on the other side. In view of the added protection it gives the car owner, it seems to me that the two-wire system is the right system to be put on a car. If I were buying a car today and the features I want were contained in the car and it had a one-wire system, I would change it immediately. I would not, absolutely, drive a car with a one-wire system. I do not care how well it be put in, how much precaution be taken in installing that one lead, even with fuses on, I would change the wiring over to the two-wire metallic system merely for my own protection. It seems to me that a car owner, who has to pay for a license on his car, taxes, and numerous other items, should have his car constructed so as to give him a minimum insurance rate. So far as I can see, the only reason the one-wire system is used is because it saves a few cents to the car builder, and this is a big item to those who are constructing and putting out a large number of cars. But the public has to pay ultimately, and for that reason I am heartily in favor of the two-wire system. I am not interested in the manufacture of apparatus which involves either one or two wires, such as lamp bulbs and lamps. Our lighting system will work on a car wired for a one-wire system or a two-wire system, I am merely stating my viewpoint as an individual.

INSULATION TEST

I would like to ask a question in regard to the report of the committee on the matter of insulation test. The report recommended a temperature of 300 degrees to be maintained for thirty minutes. I am interested to know what part of the insulation in and around an automobile is included in that specification, and would also like to have some inkling of the reasoning by which this temperature was arrived at; what particular insulation the committee had in mind when they were making the report.

JOSEPH BIJUR:—The report does not refer to the insulating covering of the wires, but to the insulation which is commonly called molded insulation, which is used in sockets, receptacles and other parts where the insulation is supposed to be solid, not yielding. The rise of tem-

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perature with time was selected so as to prepare a desirable specification which would prevent the use of compounds which are liable to acquire a distorted shape by reason of an accidental rise of temperature that could occur on a car either from receiving heat from adjacent parts or from being heated by a large electric current resulting from a short-circuit. It was determined that this temperature would serve as a criterion and distinguish between those compounds which were not liable to flow and those compounds which were. Such compounds as Bakelite, Condensite and Bakelite Fibre and perhaps other compounds still to be heard from, resist that temperature perfectly. There is no hardship and it is not expensive to get those compounds on account of this specification; whereas it completely ignores compounds that are made of shellac and rubber and various materials which look like they had good insulating qualities but upon actual use distort to such an extent as to endanger the safety of the fitting.

A. D. LIBBY:—May I ask if it was intended to include any or all parts around the magneto?

JOSEPH BIJUR:—It was intended that it should include ultimately all parts around the magneto. It is recognized that at present magneto parts are made of rubber of a high quality and that they do not distort as they become heated.

A. D. LIBBY:—Under 300 degrees of heat?

JOSEPH BIJUR:—No, I say they do not distort under the heat of practice, and it is doubtful whether they will come under this specification, but it was desired to recommend that all parts of the magneto should be made of equally heat-resisting insulation eventually.

A. D. LIBBY:—There are certain things about a magneto that I believe must be made of hard rubber. I have not seen any hard rubber that will withstand 300 degrees continuously without distorting. While so far as building magnetos is concerned, we aim all the time to get the best insulating compounds that it is practical to obtain and fulfill all the conditions, I object to having stipulated in that report any compound that would be impracticable to put into the machine to make it an operative affair.

CHAIRMAN SOUTHER:—The paragraph in question reads, "All insulating material used in connection with plugs, sockets and similar devices of electrical apparatus for use on gasoline automobiles." Now, should that be further limited or more definitely limited?

W. H. CONANT:—Just for the moment, Mr. Chairman, we may have overlooked the impelling cause of this recommendation. We are trying to forestall more drastic action on the part of the Board of Fire Underwriters. We want to lay down a trend of practice for these electric circuits such that the Board of Fire Underwriters will not later compel us to follow much more strict regulations that may seem unnecessarily harsh to us in the industry. In doing this work we have been in consultation with representatives of that board and are trying to have our recommendations accepted.

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A. D. LIBBY:—Hard rubber will withstand about 220 degrees, which is much hotter than any magneto gets, unless it is put absolutely in contact with the exhaust pipe, and in cases where it has to be in close proximity to the exhaust pipe a baffle plate is used to protect it. There are certain places in the design of a magneto or its substitute where such compounds as mentioned, Bakelite and Condensite, are absolutely not satisfactory, on account of the high-tension arc.

W. H. PALMER, JR.:—Mr. Chairman, I think we might rest on the wording of this report. For example, in the storage battery rubber is used in the jars. I think there is no idea that the storage battery manufacturer must use some other material. I think the report means just what it says: "Plugs, sockets and similar devices." Mr. Libby and the storage battery manufacturers are a good deal in the same boat; their apparatus is not referred to.

CHAIRMAN SOUTHER:—If the words "magnetos and storage batteries excluded" were put in parenthesis, would the trouble be over?

W. H. PALMER, JR.:—That seems to me unnecessary.

JOSEPH BIJUR:—It seems to me unnecessary. From the wording, "in connection with plugs, sockets and similar devices," that similarity must cease somewhere and if the interior parts of the magneto could not be made of the material in question, I think there is nothing in the report which calls for its being made of it. The same applies to the storage battery. I think the wording of the report should stand just as it is.

C. W. MCKINLEY:—In this connection I might state that several weeks ago I had an inquiry from the Underwriters' Laboratory as to the maximum temperatures that occur under the hood of a motor car.

WIRING SYSTEMS ARGUMENTS

JOSEPH BIJUR:—It may interest the members in this connection to know one or two of the reasons pro and con in regard to the single-wire system. I do not know whether it is generally known that with duplex magnetos it is impossible to use the single-wire system. The members should know that before they fit in one way or the other. That is, using the duplex magneto, as distinguished from the dual, it is impossible to ground one side of the system without using the battery side of the duplex magneto.

There is another point about the single-wire system. It conflicts to a certain extent with the use of the dash-lamp and the tail-lamp in series, which was very popular during the past year. That is to say, when the dash-lamp is wired in series with the tail-lamp it of course serves as an indicator when the tail-lamp goes out or that the owner failed to have the tail-lamp lighted. With the use of the single-wire system it is quite difficult to make this combination, for the reason that the single-wire system requires certain very special fittings, or it requires that two wires should lead from one of these lamps to the other, and that prevents socket uniformity, which is an objection to the single-wire system as a standard.

There is one other point: in connection with the single-wire system it

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is often desirable to have one common plug to go into each head lamp in which there are two bulbs, the main head lamp bulb and a smaller "marker" bulb. The plug is now a two-wire fitting in the sense that it receives one wire with the lead and one with the return, uses two wires, one of which goes to one lamp and one to the other. So that the use of two conductors embraced in a single socket would not be avoided. It is intended to retain that, or permit it.

We should all know that the single-wire system has very distinct advantages and very distinct disadvantages. Possibly the chief advantage in the single-wire system is the splendid shape of the fitting. There is a serious disadvantage with the single-wire system; every place where exposed metal occurs, any contact between that metal and adjacent metal on the car produces a short-circuit, any part whatever. That is quite contrary to the case with the two-wire system, which is like an island in the sea. It stands up surrounded by danger signs, and in fact not till it touches produces a short-circuit.

It is not just a question of doing the work carefully, it is a question of paying great attention to the detail of the design. In that connection a committee has been appointed to confer on a fitting specificaion by which single-wire systems will be made as safe and reliable as possible. The single-wire system must be put in with care. The committee hopes to specify a manner in which the single-wire system can be carried out to the best advantage.

A. L. McMURTRY:—I think this discussion is rather long drawn out. It is my opinion that the question will be settled by the automobile manufacturers themselves. As time goes on more manufacturers are adopting the single wire, so that if this discussion is carried on much longer, the question will be settled by the manufacturers.

The fittings and receptacles for the single-wire system are the only things that have delayed the adoption so far, and now that they are on the market, I feel that about seventy per cent. of the cars built in 1915 will be fitted with the single-wire system.

C. W. McKINLEY:—Mr. Bijur remarked that in using the tail-lamp and dash-lamp in series, in the single-wire system it is necessary to use a double-contact bulb in the dash-lamp and a single-contact bulb in the tail-lamp. We are using the tail-lamp and dash-lamp in series and both are single-contact bulbs. Several firms furnish the dash-lamp fixture arranged for single-contact bulbs and for series wiring with the tail-lamp.

CHAIRMAN SOUTHER:—Shall this report be submitted to the Council and thence to the Society for discussion and adoption? Are you ready for the question? Those in favor signify by saying "aye"; opposed "no." It is a vote.

Society Meeting

JOSEPH BIJUR:—In connection with this report I have been asked to give comments with regard to the portion of the report which deals with the single-wire system. We have a letter from Mr. Leonard Kebler, the

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President of the Ward Leonard Electric Company. The company with which Mr. Kebler is connected has had a good deal of experience in preparing wire for cars, that is, wiring ready to put on cars, had experience very largely with two-wire systems in which no fuses were provided and no trouble was experienced. Mr. Kebler is distinctly and unqualifiedly opposed to the use of the single-wire system, involving the use, as he thinks, of fuses, whereas a two-wire system does not; and he is opposed to the single-wire system on the general danger of short-circuit.

CHAIRMAN WALL:—The report of the Electrical Equipment Division is open for discussion. We would like to have it threshed over thoroughly.

F. E. MOSKOVICS:—Mr. Chairman, I want to warn the Society against too rapid adoption of any standard. On the formation of the Electrical Equipment Division I was a member thereof. About the first thing we were going to standardize was the dimensions of generators and motors. With the broad diffusion of ideas on those points now, you can see that we would have been sorely limited. I think starting motors or generators are made in every conceivable shape at this moment. I do not know of any two, hardly, that fit in the same place.

I hold no brief for the one-wire system or the two-wire system, but I do want to warn the Society against the adoption of a standard that has so many worthy opponents who seem to know what they are talking about. After experimenting some time with the one-wire system we have decided to fuse every circuit, which we did not start out to do. The Bosch Company have changed their designs and now fuse each circuit on their one-wire system. They did not start out with that idea. I have heard it said that all circuits ought to be fused. Mr. Bijur told me that they invariably do that on their two-wire systems. But it is a fact that the advantages in non-fusing of circuits are in favor of the two-wire system as against the one-wire.

W. H. CONANT:—I fear that the impression is being gained that the Electrical Equipment Division desires this standard—is trying to give it to the Society. That is absolutely incorrect. The Electrical Equipment Division of the Standards Committee feels that it has been called upon by the motor car manufacturers to state the proper standard, as we see it, towards which the industry is trending. For two years, I speak not from my own recollection but from the records of the Society, this question has been discussed pro and con and at previous meetings the matter has been brought before you for action. In the meantime car makers are going ahead with plans and designs, and have very decided views on the subject. It is peculiar, possibly, that the majority of this Division, until more or less recently, favored the two-wire system. I can say that positively for myself. After considering the question very seriously, after veritably sweating blood over it, we have seen the wisdom of offering the one-wire system as recommended practice. We are desirous only of pointing the way as we see it in the industry; we are endeavoring to bring order out of chaos.

The Division is not satisfied with offering simply this brief recommen-

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dation. It believes this is but the starting point for much better electrical practice. We are endeavoring, by means of a very able sub-committee, to offer improved standards for all electrical fittings as applied to motor cars. At the present time few of us are satisfied with the fittings and believe that this is but the point of departure towards the goal for which we are striving.

H. L. Towle:—It seems to me that the important points in this discussion are two: In the first place, the principal objection to the single-wire system is the fact that it is impossible under practical conditions to test the single-wire system for grounds. If you have a two-wire system a ground can occur, and the system, as Mr. Libby pointed out, can be tested for grounds before a scond ground on the other side of the circuit gives rise to trouble. But when you have a grounded return any ground is liable immediately to produce disastrous consequences. Consequently the owner has no way of safeguarding himself by periodic electrical tests.

The second point is that it would be very misleading for us to be governed by any analogy between low- and high-tension conditions. It is extremely easy to say that because we have only 6 or 12 volts it is an easy thing to insulate. So it is; but we have stiff, heavy conductors, heavy cables and so on, and the problem is not to confine the current, it is to achieve a mechanical condition in the insulation which will resist the effects of vibration, chafing and strain at the points of support.

I happen to know what the principal difficulty of a prominent maker of electric lighting and starting equipment is with the rather careless attention given to mechanical installation by the automobile manufacturers after the equipment gets into their hands. They provide slovenly battery connections, the cables are carried in some haphazard way, and so on, which does not give the electrical equipment a fair chance to show what it can do. Consequently, in dealing with this subject constructors ought to regard it as primarily a mechanical, not an electrical, problem.

F. E. Moskovics:—Broadly, the art is too unsettled to determine definitely that one system or the other holds superiority sufficient to justify it being adopted as a standard of practice. I think that Mr. Conant's expression that the idea of the committee was to represent a trend of development makes my point clear. Is it the sense of the Society that what represents a trend of development should be adopted as a standard? A trend of development before it has been sufficiently well worked out, sufficiently well practiced and gained a broad enough use to make it a standard, is not yet a standard. I do not know any phase of an automobile that shows itself so shifting, so changing, as the electric lighting and starting equipment. I know concerns that over-night change the entire equipment practically, and go to something that they did not think of before. My contention is that the art is in too chaotic a stage, that we are not settled enough to confine or restrict the limits of development by recognizing a standard practice at this time. Let the art develop. If we agree that the next year is going to bring marked progress in the art, then we will

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know more in a year from now; and if we adopt a standard and go ahead with that and say that is our idea of finality, we will surely lose dignity and prestige if our premises are proven faulty. I would argue just as strongly against the adoption of a two-wire system this time.

W. H. CONANT:—The argument just presented would have successfully prevented the Society from establishing any standard whatever or making any advance in the matter of recommended practice. I claim that the argument that if we cannot achieve perfection today we must make no advance toward it, is fallacious. This principle of "recommended practice" has been ably defined by Mr. Souther as a matter of day to day and year to year advance. We are striving to perfect the art. If we had made no strides in the matter of standards each year the Society would have failed in its functions. But because we have taken one step at a time that appeared to be forward, the Society today has achieved a great record.

Mr. Riker is an electrical engineer first. He built electric cars years ago. He is a strong believer in all that is perfection in electric devices and equipment. He has until more or less recently opposed strongly the two-wire system. He is a motor car manufacturer today with a foundation of electrical training. He is firmly convinced that the Division is right and it is only through his enlightened discussion of the matter that the Division came to its conclusion. He believes now in the single-wire system. The Division has nothing to defend in the matter—nothing to support. It is merely trying to serve the Society as we understand you desire. If we still defer this question, it is problematical whether we will ever arrive at a time when we can take any action.

R. McA. LLOYD:—I move the acceptance of the report. I wish to say that I think it is much easier to do this now than it will be a year hence. I am sorry that I cannot agree with Mr. Moskovics, but think it is going to be more and more difficult; there will be so many more systems brought out and there will be less and less effort to get up this standard of equipment that we want. The principal thing that is necessary now is to have good systems and to do the installation work well. The probabilities are that they will be more satisfactory to the public if we agree on some sort of standard and concentrate on making the fittings to a practical uniformity. I am an electrical engineer and was originally in favor of the two-wire system. But in view of the discussion in the Standards Committee the other day, which I think was quite full, I am in favor of this action at the present time. I therefore move the adoption of the report.

(The motion was seconded.)

E. H. EHRMAN:—Would it not be well to divide the report of the committee and vote on their two recommendations separately?

CHAIRMAN WALL:—That is proper, because the first part of the report has nothing to do with the second.

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R. McA. LLOYD:—I move the acceptance of the recommendation as to the insulation.

(The motion was seconded, put to a vote and carried.)

R. McA. LLOYD:—I move the acceptance of the second part of the report.

JOSEPH BIJUR:—It is useless to keep on opposing something that the majority wants, and there is nothing gained by saying the same thing to the same people, but that does not change the reason.

I think this: In the first place, everybody has an idea that the risk is just twice as great when you use a grounded return. I would like to point out that the arithmetic of that is all wrong. It would be more reasonable to say that the risk is fifty times as great. One purpose of wiring cars is that it should give good service, and another is that it should be safe. I am opposed at this time to adopting the recommendation of the single-wire system, because I think it will greatly increase the fire danger on cars. I think that if we go ahead and vote for a standard of that character merely because a greater number of motor car builders like it (some like it because it is cheap, others because it is simple, and others because they think it is best), and at the same time increase the fire hazard of cars, the underwriters will step in and tell us to stop. So I will not be in favor of the single-wire system until I see that it is safe. I think that it can be made reasonably safe but that it is inherently more dangerous.

A car when it is turned out is usually faultless. After it has got into the repair shop the lamps will have been taken apart and the fittings taken out, and the fuses worked loose, as we have men working around the car. This may be a good thing commercially, but all you have to do is touch any part of the car, and if gasoline is present, there will be a fire. With a two-wire system you can do that twenty-nine times and it will be safe, because it is not grounded. With one equipment you do not get a flash at all unless your system is grounded. It is a question with the other whether you just happen to get a flash every shot, which is quite a different thing.

Now, the single-wire system is to me a thing that it is the privilege of certain car manufacturers to use who build exceedingly good stuff and do things in an exceedingly good way; there are a few who are using the single-wire system and surrounding its use with protections that make it reasonable. But the vast majority of manufacturers would like to do it for the simple reason that they use less wire, and only for that reason; they are going to have trouble in the majority of cars.

The Electrical Equipment Division has seen that the use of the single-wire system should be conducted under certain precautions, and has started to recommend what those precautions should be, and there are a great many of them. But it seems to me that to say that we advocate the use of the single-wire system and at the same time say under what precautions we advocate it, is a mistake.

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It is regrettable that Mr. Riker, who is a firm believer in the single-wire system, and Mr. Conrad, who has had a great deal of experience with it, are not here to present their side of the case. I cannot but feel—and I speak altogether from my personal standpoint—that it is unwise at this time to accept the recommendation of the Electrical Equipment Division, which has been approved by the Standards Committee.

(Mr. Walter C. Baker assumed the Chair.)

A. D. LIBBEY:—I believe that the Society should not vote for something which has admittedly weak points in it.

W. H. CONANT:—In justice to the Division and the Standards Committee, I feel that it is in order to make the point of no quorum. I think there are not enough of us left here to decide this really important question.

W. G. WALL:—Mr. Chairman, I believe that we should recommend standards as we go along. I do not believe, however, that standards should be recommended unless a large majority of the Society are in favor of them. I think that the standards that we have recommended have met with the hearty approval of a large majority of the members—which means a large majority of the manufacturers. This wiring subject has brought up considerable discussion, and there can be no doubt that there is great opposition to the single-wire system. Personally I am very much opposed to it. I hardly need give all the advantages or disadvantages of the single- and the two-wire systems. The single wire without question has a great many advantages. The low first cost is one of these. The double-wire system is, I think, without question safer; that is the principal reason I have been in favor of it. There is some trouble in making perfect grounds with the single-wire system. When you use a single-wire system there is no doubt that you have a large number of grounds to make, some of which are liable to be imperfect or become imperfect, due to rusting or corrosion. So it has always seemed to me that we would be safe if we should use a two-wire system.

In a case like this, where there is such a large number of members opposed to acceptance of a standard, its acceptance should at least be postponed for a while.

F. E. MOSKOVICS:—Mr. Chairman, I believe that Mr. Conant brought out the point at issue. Mr. Wall also touched on it. It is not a matter whether a slight majority favor something that might be called a general trend, but whether there is a real demand from the Society. Before voting I want the members to consider seriously that they have heard several able engineers give some pretty good reasons in favor of the two-wire system.

H. G. OSBURN:—Mr. Chairman, the demand for a three-light system on cheaper cars has been called to my attention. When only three lights are installed, better insulation is desirable. It is nearly as cheap in three-light installation to use the two-wire system. As the motor

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circuits are usually two wires, it only means the possible cost of the two runs that have to be made to the headlights, which are the principal runs, for the reason that the headlight regulation or dimming is more easily accomplished with two wires to the lamp with double-contact receptacle; therefore the increased cost of the two wires to the tail-light is somewhat compensated for in more simple methods of headlight regulation. I think in view of this it is just as well to delay final action and perhaps better meet this demand.

A. L. McMURTRY:—Some of the members here seem to forget that it is simply recommended for practice, not recommended as standard equipment.

I was on the committee last year. Out of the twenty-one letters we sent out asking about equipment, we received eleven replies favoring the one-wire system; four were non-committal and the rest two-wire. Two of the men who made the most strenuous objection to the single-wire system are building cars today fitted with it.

When you consider the number of cars being turned out today fitted with the one-wire system, and the number of cars that will be turned out in 1915 with it, I think it is up to the Society to recommend as practice the one-wire system, because I firmly believe that the one-wire cars will be in the majority, and as soon as the system is recommended as practice, the lamp makers will make up the single-contact-base lamp in the same quantity as they now do the double. I have heard a lot of objections to the one-wire system, mainly about fire and so on. I would like to ask why such large concerns as the General Electric Company wire their gasoline-motor-driven railway cars, carrying voltages up to 800, with a one-wire system, if it is so dangerous, and if it is just a matter of cost; and if there is all this trouble about the one-wire system, why do they not burn up more trolley cars?

F. E. MOSKOVICS:—The answer is very obvious. The systems that Mr. McMurtry mentions are handled by experts and taken care of minutely in shops, cleaned and washed, and get the very best attention. I think Mr. McMurtry's own car does not receive as careful attention. I know mine does not.

W. H. CONANT:—I thought that my point of no quorum might bring this matter to an issue. Some of the very best arguments have been overlooked entirely. I do not feel it fair to argue this question at this hour of the day and if, Mr. Chairman, you contemplate a vote on the motion, I would press my point of no quorum, because the other side of it has not been presented and cannot fairly be, at this hour.

R. McA. LLOYD:—This question was scheduled for this afternoon. If anybody wanted to vote on it he could come. I think we should have this vote. Mr. Bijur said the only advantage in the single-wire system is that we save a little wire. I think that is a distinct argument in its favor. If anybody has had any experience with the wiring of cars, he wishes he could save half of it. There are a lot of things that

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get more and more complicated with two wires, and it is natural that we shall make the one-wire system better.

DAVID FERGUSSON:—Our company used the double-wire system until two years ago. We frequently had trouble. We wired in the best manner possible. We called the electricians in to make an investigation and found that the two-pole lamps and fittings were absolutely inadequate in regard to insulation for the purpose. We felt we could not go to work and re-design those lamps. We had to use standard lamps. We called the electricians in again and they advised the single-wire system, and we adopted it as a standard. I think many other companies have done so. We have had it in use two years on somewhere in the neighborhood of five thousand cars. Some of them must have run nearly a hundred thousand miles by this time, and I have not yet heard of a single accident from a car catching fire from anything going wrong with the wiring. The lamps and fittings are altogether superior to the two-wire lamp sockets, &c. We believe the single-wire system is altogether preferable.

F. E. MOSKOVICS:—The company I represent are using the one-wire system. I will not argue on the matter of economy. I am urging that where there is so much difference of opinion, we ought to postpone action.

CHAIRMAN BAKER:—It seems that we have discussed this matter quite thoroughly.

W. H. CONANT:—I press again my point of no quorum. The Constitution says that fifty voting members must be present.

CHAIRMAN BAKER:—According to the Constitution there must be fifty voting members present to constitute a quorum. There are not fifty voting members present at this time.

ROLLER BEARING SIZES

DISCUSSION AT CAPE MAY OF BALL AND ROLLER BEARINGS DIVISION REPORT

STANDARDS COMMITTEE MEETING

DAVID FERGUSON:—The only report we can make is one of progress. It was resolved at a former meeting that some of the sizes of the present roller bearings that the manufacturers are now using should be eliminated. Here is a list of the 287 sizes used at present (shows list). There is a list of 47 that has not gone before the committee, to replace the present list. We thought it would be better for each member of the Division to have a copy of this proposed list, to go over carefully and either add on any other bearings that should be added, or take off some before submitting the matter to the Society.

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CHAIRMAN SOUTHER:—Mr. Fergusson, are we to understand that the ball bearings work is substantially cleaned up and that the Division is now devoting its energy to similar work in connection with roller bearings?

DAVID FERGUSSON:—Yes, that is as I understand it.

CHAIRMAN SOUTHER:—It is perfectly clear from certain correspondence that we have in our possession that some of the roller bearing manufacturers do not desire the cutting down of the number of bearings. They do not recognize the advantage to be gained by the manufacturer of roller bearings, the manufacturer of cars or the users of cars. This is a point of view that personally I cannot understand. If 50 sizes will do the work done by 300, roughly speaking, surely there must be some advantage to be gained. The method of procedure will be along the usual lines, that is, to determine a minimum list of sizes that will cover all the uses and put that minimum number of sizes in the Data Book and Transactions, with the hope that it will be so attractive to the buyer of roller bearings and the manufacturer of cars that it will become standard practice.

It seems to me that if a thing is good it grows because it is good; if the committee will hang up a reasonable number of sizes that will cover all needs, the work of the committee will be done and the industry will do the rest.

HOWARD E. COFFIN:—To get information as to the attitude of some of the bearing manufacturers, I would like to ask whether this list of 300 sizes is common to all roller bearing manufacturers or a compilation of all the sizes made by all the different concerns. Is it for commercial reasons that some of these bearing manufacturers desire to keep a large variety of odd sizes, or is this an ailment common to all manufacturers?

F. M. GERMANE:—It is common to the makers of taper rollers. The Standard Roller Bearing Company have a list of 287 roller bearings that are constantly being called for by manufacturers of cars and parts of cars. Possibly the Timken list embraces fully as many sizes, if not more.

HOWARD E. COFFIN:—Is this a condition that they themselves welcome or would they rather make fifty or seventy-five sizes?

CHAIRMAN SOUTHER:—No, Mr. Coffin, they prefer to make the fifty-seven varieties. There is a reason for it. We can afford to carry in stock a certain quantity of fifty-seven varieties, but we cannot carry in stock two hundred and eighty-seven. We do not know what the demand will be from season to season; at least a dozen different sizes are added. For example, there is one series, the B24 series, in our bearings, in which there are nineteen sizes, and there is not much difference in the size of one bearing from the other; one has perhaps a sixty-fourth larger or smaller bore; in the curve and fillet of another one, the chamfer, there is a slight difference, or in the width of the

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bearing or in the outside diameter. All those things make special sized bearings which it is impossible to carry. In this sheet that was prepared forty-seven sizes practically cover the entire range of automobile requirements. I believe that if the committee goes over these sizes, adding three or four, perhaps a dozen more, a series of sizes will be presented that will cover the full range of requirements, as to both size and capacity of bearings, all parts of not only of the pleasure but of the commercial vehicle, and the entire range of the demand of the parts manufacturer as well as the car maker.

Are there any further suggestions and thoughts on this matter which will help the committee in its work?

HOWARD E. COFFIN:—Is not it about the same old question we have discussed a great many times—like the steel tube situation, for instance. Are not those sizes in existence because motor car makers insist on having them? And are they not going to keep on insisting on having them until there is a prepared list of some fifty standard sizes, laid down as stock sizes, which can be gotten without delay? If makers order anything outside of that list, let them take the time penalty and the cost penalty.

CHAIRMAN SOUTHER:—It seems to me an exactly similar case. If fifty sizes are put on our data sheets and the draftsman sees a size of hole and bearing he will probably design his spindle of that size rather than a sixty-fourth larger or smaller. If there is nothing before him he naturally goes to something which he can get from calculation; he adopts a calculation because there is no particular reason, as far as he knows, why he should not. Whereas if he has a list in front of him with probably the bore sizes, the steppings up, outside diameters and capacities numbered, surely he will find one that will come near his calculation, and perhaps adopt the next larger size to be safe. It seems to me the thing is bound to work itself out. The committee has not attacked it before because it has been busy working out refinements of the annular ball bearing situation.

F. G. HUGHES:—Mr. Chairman, in regard to this proposed standard, as representing a ball bearing manufacturer, it has always been my hope that eventually the roller bearing would be standardized to metric dimensions as to both bore and outside diameter, with possibly a variation as to width. This would allow the car manufacturer to use the same size plugs and cutters for sizing up his stock to which the roller bearing is fitted, as he would for the ball bearing which he commonly uses. It is extremely unfortunate from the appearance of the situation here, that we cannot standardize to the metric dimensions entirely.

There are two series of roller bearings commonly used today which interchange as to metric dimensions in the main with the annular ball bearing sizes. One is the annular replacement series, which is made by the Timken Roller Bearing Company; this has the same bore size and outside diameter as the S. A. E. standard annular series ball bearing. There is another series made by the Bower people and the Standard

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Roller Bearing Company, which in a way has automatically come to be a standard. This list has the same bore and outside diameter as the standard S. A. E. ball bearing list, but the width is the same as the N. D. double row ball bearing. This list has of late years become popular because several makers have introduced double-row ball bearings made to correspond closely with the N. D. double-row bearing in width and a number of manufacturers of cars and parts have seen fit to adopt certain roller bearing sizes which correspond to these double-row ball bearing widths, interchanging roller or ball bearings, just as they see fit.

As one representative axle maker told me the other day, it is hoped to use ultimately nothing but interchangeable series in their double-row ball bearings and their roller bearings, because it gave them a range of possibly twelve manufacturers from whom they could get an anti-friction bearing and, moreover, from stock without delay.

Referring to this list of 287 sizes of roller bearings now carried on the books of several manufacturers, it is indeed fortunate that it seems possible to reduce this number to forty-seven sizes. It is quite unfortunate, however, that we cannot see our way clear to come to metric sizes, when it would be possible, I believe, to reduce these forty-seven different sizes to possibly twenty, and cover every size that the truck and pleasure car manufacturer would customarily use. If we use the inch sizes we will be compelled to have the approximately fifty sizes if we are successful in standardizing as we hope to do, but if we continue under the present methods, we are going to have three hundred-odd sizes and apparently the longer the standardization is deferred the more sizes there will be, and it may well be that ten years from now we will have three thousand sizes instead of three hundred.

To my mind, while not interested in the roller bearing future, it seems almost criminal to allow a situation of this kind to continue longer, a situation wherein every engineer may vary his sizes by a sixty-fourth or a ten thousandth or some other ridiculous figure and add to this already burdensome list.

Another feature of this situation with the large list of sizes is the fact that the larger the list the less competition there must be in the industry, for my experience in the ball bearing field indicates that the tool cost requires a capitalization of about $8,000 per size, and with this enormous list of approximately three hundred sizes one can see what capital investment there must be to produce this large variety readily.

I hope that the Society will approve a report from the committee cutting down the large number of roller bearing sizes into an easily workable number, either metric or inch, which shall be used as a standard, and I hope that in the course of the next few years these roller bearing sizes will be standardized in the metric dimensions, to sizes which will interchange as to outside diameter and bore with the S. A. E. standard ball bearings, which will allow an interchange of the reamers and gaging tools between the annular bearings and the taper roller bearings, for, of course, this standardization we are referring to refers particularly to the taper

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roller bearing, and only to a few straight roller bearings, and not at all to the Hyatt, which I think is an entirely different proposition. My personal opinion has been that if we could report, for instance, a tentative list of forty-seven sizes, the members of this Society criticising the report, we could possibly arrive at a standard sooner than otherwise. We know how the Ball and Roller Bearing Division worked for years to standardize the limits and dimensions of the annular series bearings, and it was not until the committee was prepared to submit a report for final adoption that something was done definitely towards coming to a standard annular ball bearing. The ball bearing manufacturers then got together and directly the whole thing was threshed out, and the matter is over with and standardized now. If we do not do something of the same kind with the roller bearing standard, I believe we can keep on fooling with this proposition for many years. This standard is one of very considerable importance, I think.

CHAIRMAN SOUTHER:—I think there will be no argument on that question.

W. C. BAKER:—Mr. Chairman, I think that point is very well taken, and I hope that the committee will as far as possible make those standards interchangeable, that is, between balls and rollers.

CHAIRMAN SOUTHER:—It is certainly very desirable, if it can be.

F. M. GERMANE:—The 47 sizes proposed were selected from our knowledge of the automobile and automobile parts manufacturers' requirements, embracing a range of sizes and load capacities that will fill every requirement of the user of taper bearings. Some changes in dimensions have been made in the proposed G and MG series, as a large number of the present list of 287 sizes are the result of manufacturing bearings to suit automobile makers' requirements where parts in which the bearings were used have been designed without any regard to the original standard list of taper bearings Twenty-one of the proposed 47 sizes are the G—heavy series, and the MG—medium series. Fifteen are the ND series interchangeable with New Departure double row. Eleven are LG series, interchangeable with annular ball bearings. We hope eventually to eliminate the LG series and manufacture the G and MG series in metric dimensions so that the i.d. and o.d. dimensions in the entire series of taper bearings will interchange with annular ball bearing dimensions.

CHAIRMAN SOUTHER:—Is there any further suggestion? It seems to me this is a very good report of progress and that Mr. Hughes' suggestion that something be hung up for a target is the right way to get results. Supposing it is not absolutely right the first time, criticism and attempted use will bring out why it is not quite right, and of course it can be rectified. It is what we did with the tubes long ago. We reduced from eleven hundred down to half that amount, for a starter, and then went on the next time still further, because we found it was possible.

This report of progress, then, unless there is some objection, will be submitted to the Council and a brief statement made to the Society

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as a whole of what is being attempted; and it is certainly very desirable during the presentation to the Society as a whole that endorsement of the committee work be given openly. The committee needs encouragement and an open statement such as Mr. Baker made, that it is a desirable thing to aim at. When we have among us a very powerful roller bearing company that does not want it, then we must have in the Society, among the engineers, a real demand for it because it is fundamentally good. A thing that is fundamentally good must come some time. If eventually, why not now? That is all.

PLEASURE CAR WHEELS DIVISION REPORT

DISCUSSION AT CAPE MAY

Standards Committee Meeting

E. R. HALL:—The report of the Pleasure Car Wheels Division is in the June, 1913, number of the Bulletin, on page 174, and is in such form that you can all read it, so perhaps it would be better for me to simply go over it and mention the main points which the Division has covered.

In considering the standardization of wheels for pleasure vehicles, our attention was immediately directed to the large number of rims in use and we thought the best thing to do at first was to evolve certain specifications to cover the testing of these rims, to determine how safe they are to use, and then possibly work on limiting of the number of sizes, the standardization of types, and from that work into the wheel itself.

RIM TEST SPECIFICATIONS

We have prepared a set of test specifications, and after testing a large number of rims now in use, feel sure that rims which meet our requirements in this respect are properly strong for practice. On page 174 of the June Bulletin you will note a table showing these specifications of D, E and F section automobile rims. The maximum pressure to which we test these rims in our recommended specifications for testing is approximately twice the pressure prescribed by the tire manufacturers for the tires. We specify a maximum allowable deflection after testing to this pressure and returning to a basis of 25 pounds pressure, and also specify a maximum allowable permanent set at 25 pounds pressure after completion of the test; these measurements being taken at H in the drawing shown on page 175 of the June Bulletin.

The procedure of the test which we recommend is to start at 25 pounds and take initial reading at H, then increase the pressure by increments of from 20 to 25 pounds, returning each time to 25 pounds inflation and measure each time deflection and set. The safest and most correct way to make these tests we find is by water pressure.

The committee has worked up a series of plots showing results of

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tests on the various sizes and types of rims tested which may be seen in the June Bulletin on pages 175 to 179, inclusive. The curves made up of crosses correspond to our specifications for the tests, showing the maximum allowable deflection and set. The other curves shown represent the results obtained from the various rims tested. As will be noted, the rim test curves which lie in the area below the cross line represent rims which are safe according to our specifications, while the curves lying above the cross line represent rims which we would consider as not having sufficient safety factor. Our tests have been made on the most common sizes of rims.

You will note on the 4½" plots that the curves representing a number of rims lie in the danger zone above the cross line, while there are a large number which lie in the safety zone. In practice we have located no objection to the strength of the 3½" and 4" rims, but we do learn of trouble being experienced with some types of 4½" rims. Thus practice would seem to bear out the correctness of our specification. The question has been raised whether our 4½" specifications were a little too severe, but judging from this trouble which has been experienced in practice, and also from the fact that the majority of rims with which no trouble has been experienced lie in the safety zone, the committee believes that the specification is not too severe. In this connection we must also remember that oversized tires are frequently used on these rims.

TIRE SIZES

The Division has suggested a very much reduced list of tire sizes as standard for automobile manufacturers, as there are a very large number of different sized tires manufactured to-day; the same is true of rims, and the committee has endeavored to eliminate a large number of these sizes and to standardize a few which will meet the requirements of the trade. This list is shown on page 179 of the June Bulletin and is still under advisement, as we have in mind the possibility of adding another size or two, particularly of 5" size.

CHAIRMAN SOUTHER:—Do you carry in mind the number of tire sizes commonly used now and what percentage of the number of sizes used is covered by this table, roughly speaking?

C. C. CARLTON:—There are 46 to 51 or 52 different sizes.

E. R. HALL:—Somewhere around 50, and here we now list 8 sizes.

CHAIRMAN SOUTHER:—Is it not true that 85 per cent. of the consumption is within those possibly?

E. R. HALL:—Fully 85 per cent. of the automobile tires manufactured and used to-day are of the sizes listed in our recommended standard.

CHAIRMAN SOUTHER:—Mr. Fergusson, you were the cause of a great deal of good work that has been done by this committee. I am sure the members present would be very glad to hear of your experience with the large-sized rims, those of 36 by 4½, or the F section, as it is called, showing that some work of this kind is necessary. I think it is not too well known in the industry as a whole that there was any size or char-

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acter of rim that was in particular jeopardy. It seems to be a fact, and I think what Mr. Fergusson may say will indicate a starting point in this investigation.

DAVID FERGUSSON:—Our company had a great deal of trouble with demountable rims when they first came into vogue about three or four years ago. Every Tom, Dick and Harry was making one, and there was no satisfaction in putting them on a car. Our customers would specify a certain make of demountable rim and we had as a rule to put it on. We hated to do it in many cases and advised against it, but in many cases the customer insisted in putting on that rim, and in some cases accidents happened. That gradually brought up the fact that there was no rule at all to make those rims by, anybody made a new rim in any way that he saw fit; there was no standard pressure recognized that these should withstand, with the result that we held back for a whole year from putting on demountable rims after everybody else adopted them, because we could not really find anything that met our idea of what a rim should be. We even had trouble with several quick detachable rims of recognized standard makes, especially in the case of the 36″ by 4½″, using a 37″ by 5″ tire, and what was most surprising was that the rim makers could not tell what pressure they would bear. We made experiments ourselves and found that many quick detachable rings would blow off at very little more pressure than the pressure that the tire makers recommended for tire inflation. I think that was what brought this matter before the Society. I think that even now the 37″ by 5″ tire on the 36″ by 4½″ rim is not quite safe. We certainly ought to specify a pretty high test pressure for tires on standard rims. They have a lower factor of safety than any other part of the car.

CHAIRMAN SOUTHER:—It is a fact, it is not, Mr. Ferguson, that you have finally obtained a special material and special treatment of it that give you a strong Q. D. rim?

DAVID FERGUSSON:—We have specified a high carbon steel specially heat treated rim in order to make it stand up. But I think that even now it is the weakest part of the car.

CHAIRMAN SOUTHER:—The committee tested one of the rims that Mr. Fergusson complained of as being weak, and also one that he recommended as being strong enough, but not too strong. The tests made confirm his practical experience. And the safety limits for deflection and set suggested by the committee conform to those figures very largely.

E. R. HALL;—In touching on what the Division has done I failed to bring out the fact that the rims were tested under the worst possible conditions that could be applied in practice. For instance, all clincher-type rims were tested using soft extensible bead clincher tires, whereas in practice the majority of tires used on these rims are of the Q. D. clincher type, having partially or wholly inextensible beads, which are much less severe on the rim. Our specifications we feel are sufficiently stiff to provide ample safety when oversized tires are used, such as a 37 by 5 tire on a 36 by 4½ rim.

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CHAIRMAN SOUTHER:—Would you mind stating why the soft extensible bead tire is worse on the rim than the more or less extensible bead or stiff bead? In other words, how does the rim fail? That is what it goes back to.

E. R. HALL:—The rim generally fails on the side. If the rim has a side ring it is either lifted out of its gutter or rolled so that it snaps off. When a clincher tire is used the side flange of the rim has to take care of both horizontal and vertical components of tension brought to bear on it by the tire wall. The combination of this vertical or upward pressure with the horizontal is very severe on the rim, the tendency being to lift or roll the ring or side flange. When Q. D. clincher tires are used the upward or vertical component is either very largely or wholly taken care of by the fact that the circumference of the tire bead itself cannot be increased, so that the rim has only to take care of the horizontal component, the effect of which is very much less severe than the effect of vertical and horizontal components combined.

CHAIRMAN SOUTHER:—A further branch of the work of the committee is the attempt to bring together the various demountables, so that there will be a standard wood felloe diameter and width. It may be that we will not succeed, but with the idea of bringing out all the points that the committee faces in its work, one or two papers will be presented before the Society on this subject. The papers will be of an educational type. We will all have a chance to hear them and read them and perhaps come forward with suggestions; but the committee itself is stalled for the time being on that subject. It must be threshed out. There is a difference of opinion, perfectly justified, an amicable difference, and we want light on the subject. That light will be given by these papers which will be read this week.

Are there any further remarks on the work of this committee?

C. W. MCKINLEY:—Mr. Chairman, I would like to ask whether those tests were made with the later type of demountable rim, with what are called the wide section rims for straight-side tires, under road conditions, with the tire partially inflated, which is apt to be the general rule.

E. R. HALL:—The Division made no attempt to test these rims except by what we call "dead test," to determine the effect on the rim of the various inflation pressures of the tire. We did not attempt to approximate road conditions.

C. W. MCKINLEY:—We tested out a number of different makes of this type of rim; straight-side, 34 by 4, run at approximately 45 pounds pressure. We drove 35 or 40 miles over the ordinary country stone road, and the rims were flattened down as much as $\frac{3}{8}$ of an inch from actual true diameter, which appeared to be very bad. If that should continue, the rims would become useless in a very short time.

CHAIRMAN SOUTHER:—It was the battering effect of the car pounding on the road, because there was too little air?

C. W. MCKINLEY:—Yes. We found the same condition with the full

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inflation driving over ordinary roads. You often hit a stone or a railroad track. Driving in a street car track deflects the edge from true measurement an appreciable amount, and the rims would be badly damaged probably after 3,000 or 4,000 miles' use.

E. R. HALL:—The point Mr. McKinley brings up is one of rim design, with which the Division has not dealt. This matter may come up later on. It is true that some straight-side rims can have their flanges battered more readily than the corresponding size in clincher type, the latter being reinforced by its hook. Straight-side rims can be made with the edges of the flange turned under, resulting in very much increased strength.

C. W. MCKINLEY:—This showed up more in the demountable type than it did in the old quick detachable, because the detachable ring of this old type rim, being of heavy section, stood up well under pounding on the road. All the pounding seemed to be on the outer portion of the rim. The inside portion seemed to be in good shape.

C. C. CARLTON:—Did you test out the narrow rims or just the wide ones?

C. W. MCKINLEY:—We did not test out the wide ones.

R. S. BRYANT:—The effect Mr. McKinley speaks of is simply due to the concussion of hitting the side of the rim on the car tracks and cannot be avoided very well unless you have a great deal heavier rim.

CHAIRMAN SOUTHER:—Mr. Sweet, have you come across anything of this character with the straight-side tire?

E. E. SWEET:—No, sir.

E. R. HALL:—It is probable that the Division specifications for rim strength will eliminate the rims which give the defects of which Mr. McKinley speaks, as you must have strength there in order to stand our test.

CHAIRMAN SOUTHER:—The thought of the committee is that in the absence of this knowledge that there was any real weakness in rims, the makers paid very little attention to the strength and materials used, because it did not seem to be necessary, but now that attention has been brought to it there will be a selection of material that will be much more suitable for the work to be done.

You will notice that we have not given any names here at all. The names of these various rims are absolutely in the hands of the committee and will remain so. A certain length of time which we agreed upon, say six months or a year, has been given to bring about the improvement of material that seems very desirable.

OVERSIZE TIRES

C. C. CARLTON:—Mr. Chairman, I would not like to see the report of the committee passed over without a little further attention being given to the list of tire sizes. I wonder if there is any objection to this list of tire sizes. It is a very radical recommendation, when you stop

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to think of it, reducing the recommended number of tire sizes from some 50 down to 8. It was the opinion of the committee that only *standard* sizes should be here listed and that the oversizes should be at the consumer's option. For instance, when you say 32 by 3½, it is not the desire of the committee, as I understand it, to eliminate the 33 by 4 oversize, and in the 36 by 4½ to eliminate the 37 by 5 oversize tire, but merely to recommend the regular sizes as the standard sizes to be recommended to the car manufacturer, leaving the oversize tires to the option of the car owner. In addition, the committee will note the elimination of the 36 by 5 size entirely, which has been a very popular size and is still in some use by car manufacturers. I would like to add just a word on the 36" by 5" size. A part of the committee was very much in favor of the addition of the 36" by 5" tire to this list, with the added suggestion that a corresponding 5" rim section be adopted for use in connection with it. There are a great many cars, especially seven-passenger, carrying 36" by 4½" tire equipment which are really overloaded. If the customer uses 37" by 5" oversize tires they must be purchased as additional equipment. Some seven-passenger cars have 34" by 4½" tires and some 35" by 5". These sizes are preferred because of the smaller wheel diameter. Many manufacturers prefer a 26" wheel diameter to a 27" and at the same time need a 5" tire rather than a 4½". This can only be secured by the 37" by 5" tire which needs a special 5" rim in order that it may give the best service, instead of being squeezed into the 4½" section to which it has always been applied.

CHAIRMAN SOUTHER:—Does not that new rim have to go back to the Clincher Tire Association?

C. C. CARLTON:—Yes.

CHAIRMAN SOUTHER:—Then that is probably not within the province of this committee. The Clincher Rim Association already have that up for consideration at the present time.

Mr. Carlton, you spoke of oversize tires. How many would be added to this list if they were all printed?

C. C. CARLTON:—31 by 4 for the 30 by 3½; 33 by 4 for the 32 by 3½; 35 by 4½ for the 34 by 4; 35 by 5 for the 34 by 4½; 37 by 5 for the 36 by 4½, and 39 by 6 for the 38 by 5½.

CHAIRMAN SOUTHER:—That is six additions, or possibly seven, with the 36 by 5, on top of this list of 8, indicating the extreme upper limit. That is not a very serious thing in place of 50 sizes now existing.

C. C. CARLTON:—There seems to be no dissension among the tire companies as to these sizes.

CHAIRMAN SOUTHER:—Where will the opposition come from?

C. C. CARLTON:—I cannot see that there will be any opposition.

CHAIRMAN SOUTHER:—Then why are there 50 sizes?

C. C. CARLTON:—Because the Society of Automobile Engineers has not taken hold of the matter before. Even now new cars being manufactured take some new tire sizes that have never been used before.

CHAIRMAN SOUTHER:—What is the idea?

C. C. CARLTON:—The tire companies do not welcome it, surely. It

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seems to be an idea on the part of the engineer to get tire sizes that nobody else has ever used before. That is the only reason I can see.

CHAIRMAN SOUTHER:—Shall this report be submitted to the Council and to the Society as a whole? Are there any remarks? Those in favor signify by saying "aye"; opposed, "no." It is a vote.

Society Meeting

HENRY SOUTHER:—The gist of the first paragraph of the report is that the user, the manufacturer, is not interested when the rim bursts or fails entirely, but when it deflects seriously enough to prevent the proper carrying of the tire. The tire makers are naturally very much interested in the shape of the rim while it is at the usual pressure, not at bursting pressure.

The idea is to put on a predetermined load, so that all the take-up or lost-motion will be taken up before the test begins. The deflections given in the table are the results of a great many tests, which are graphically illustrated in the report. The straight line of crosses in these plotted curves and charts represents the standard deflection and set permitted under these specifications. The other curves show the actual results of tests. It will be noted that the smaller sizes of rims, 32 by 3½, 34 by 4, were all safely within the desired standard, and that all the exceptions are in the 36 by 4½ size. This corresponds with experience. There has never been any trouble with the smaller-sized rim, but there has been some trouble with the same makes of the larger-sized rim.

No names have been given in plotting these curves, for very obvious reasons, and no attempt will be made to suggest the enforcement of these specifications until January 1 of next year, in order that the manufacturers may prepare better material or better treatment or strengthening of another kind by that time.

The original intention of the committee was to standardize some form of rim. It seems impossible at this moment to do that, there being three forms, certainly two, which are bound to exist for a time, at least, and the standardization will be performed by experience and the survival of the fittest. The matter of standardized demountable rims and fixtures is not ready for a report. There are a great many differences that must be reconciled and a great deal of light must be let in upon the subject before we shall be ready. We will make some attempt to do that by one or more papers at this meeting, setting forth the opinions and difficulties that the committee faces.

The next subject which the committee undertook to simplify was the number of tire sizes in use. At the bottom of page 179 of the June Bulletin is a list of eight sizes of tires, these eight sizes covering 85 per cent. of the demand. Fifteen per cent. are outside of the eight, and in this 15 per cent. are the oversize tires, such as 37 by 5, to be used on the 36 by 4½ rims.

The idea of the committee on all those outside is this: manufacturers specify one of the eight sizes, and possibly there would be one or two more—nine or ten sizes, as standard equipment, and that they shall be

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furnished at about regular prices. In other words, they shall be the standard tires. Now, then, if the purchaser wants an oversize tire he can get it—there are only four or five of them—but he would pay a little more money for it. This would tend to concentrate all on the standard sizes.

The report of the committee is not complete except as to the table of inspection for rims. That seems to be complete, but at the same time I want to say this, as chairman of the Standards Committee: that the report is not final when it gets to this stage; everything recommended by the Divisions and by the Standards Committee as a whole should be fully discussed at a meeting of this character. There are a large number who cannot and who do not attend committee meetings and they must say their say here or else take the consequences, so to speak. That will come up in connection with several other reports. We want the fullest discussion at this open meeting, where everybody is supposed to come, and we want it right now in connection with this report. Any suggestions or help or new business offered will be very gratefully welcomed.

CHAIRMAN WALL:—Gentlemen, you have heard Mr. Souther's report. I know of no report which proves to us the advantages of standardization any better than this does, and I believe that the average layman will comprehend the advantages of some of our other standards work. We wish discussion of all of these reports, especially one of this kind. The report is now open for discussion.

ORREL A. PARKER:—I think that the report is splendid, and believe that its adoption might be helped if the fact were pointed out that in addition to the economy to the manufacturer and dealer, there is an economy to the actual user of tires through the selection of what might be called well-balanced tires; that is, tires of a sufficient cross-section but not too large a diameter. It has been my experience in examining tire troubles or solving them that the well-balanced tires seldom cause trouble, but tires that are very large in diameter for their cross-section or very large in cross-section for the width of rim, not only cause trouble in the construction of the tires themselves but in the fit of the tires on the rim. I know of a conspicuous trouble with the 32 by 3 straight-side, where the wire base was not the right size to fit the rim. That was some two years ago, and it has been remedied. Difficulties have been had also with 37 by 4½ oversize on 36 by 4 rims, the 4-inch rim being about ⅜ of an inch narrower than the 4½-inch rim that should be used. The economy to the user as well as to the manufacturer should make the speedy adoption of this report practicable.

DAVID FERGUSSON:—I certainly would advocate the use of the 37" by 5" tire. A very large number of makers are using that size as a standard and it is a very suitable proportion. There certainly must be a 5-inch tire for heavy cars. For 48-horsepower six-cylinder cars, weighing close to 5,000 pounds, there is nothing in this proposed list between 36 by 4½ and 38 by 5½, which is certainly a big mistake. Although there is a move to standardize another size here, 36" by 5", I do not see the use of doing this, when we have another that is already a well-recognized stand-

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ard, viz., 37 by 5, used on thousands of cars at the present time.

E. R. HALL:—Answering Mr. Fergusson's objection, the Division has suggested a tire standard comprising tires of even tread diameters only. Tire manufacturers will doubtless make oversize tires for the majority of these tire sizes.

The 36 by 5 tire now in use is applied to a rim of the 4½-inch section, although called a 5-inch rim. A 37 by 5 tire will naturally be manufactured to oversize 36 by 4½" equipment, giving a tire of slightly greater capacity than the present 36 by 5. Any 5-inch tire on a rim of 4½-inch section gives an oversize condition of a tire too large for the rim, which, although generally proper for consumers, is not a proper equipment for automobile manufacturers. A manufacturer should never turn out a car with tires which cannot be properly oversized. If the car is initially equipped with present 5-inch tires, which always go on rims of the 4½-inch section, the consumer has no opportunity to properly oversize, as the only size available for oversize is the 5½-inch size tire on a 4½-inch section rim, which is very undesirable.

The matter of standardizing a new 5-inch tire, probably in 36" by 5" size, to fit a new 5-inch rim of larger contour than the present 4½-inch, which rim will properly take a 5½-inch tire as oversize, is now under advisement by the Clincher Automobile Tire Manufacturers' Association, and as soon as there is anything definitely decided the matter will be taken up with the Pleasure Car Wheels Division of the S. A. E.

HENRY HESS:—I would like to add my experience as a user to Mr. Fergusson's statement. I have driven a pretty heavy car with 37" by 5" tires for five months over all sorts of roads, and at the end of that time still had original air in one or two; had not even pumped them up again. I think this is not exceptional, because I have had out of nearly every tire that I have had on the car an excess of 5,000 miles, and in some cases I have had nearly 10,000 miles. I therefore say that the size of 37 by 5 which Mr. Fergusson advocates is an exceedingly useful one, as proven by experience, on a car of that weight.

B. B. BACHMAN:—As I recollect the discussion in the Standards Committee meeting, the idea was that the eight sizes listed were to be the proposed standard of even dimensions, but that that did not mean that there would not be oversize tires of possibly four or five different sizes acting as a reinforcement of this proposed standard. I understood, too, Mr. Hall's remarks at that time, as this morning, that there are in contemplation five or six additional oversizes. I think 37 by 5 should be included, because that, with several others, was to be in addition to this. These I understood were to be the standard tires to be proposed, not including the oversizes.

HENRY HESS:—The resolution, while permitting the oversize tires, because of their utility, would result in a cash penalization of their users; that would be just only for freak sizes, or sizes not warranted for standard cars turned out by important car builders.

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HENRY SOUTHER:—I am afraid that is so. If a man is driving a heavy car, he has to have a heavy tire. As near as I can find from the tire manufacturers, everybody has to pay for them.

HENRY HESS:—But the report states that they pay extra for them.

HENRY SOUTHER:—Well, call it extra, if you like; more than the regular.

G. L. MARKLAND, JR.:—Would it not be well to consider the car entirely in this case? If a car built for maximum service is used for maximum service, put a heavy tire on. Mr. Hess states that he gets good results. Do not have two sizes on your car, though; put one size on and keep it there. That is the idea of the Standards Committee making a standard for certain cars.

HENRY SOUTHER:—I think there is a very good reason for that: that is, if you make the 37 a standard somebody will come along with a 38 by 5½. In other words, a certain group of drivers always ask for a little bigger tire than the car manufacturer handed out as standard. Therefore if the car manufacturer hands out 37 by 5, the user is coming along and going to ask for 38 by 5½ or something else. That is the exception, however. As a rule the buyer takes what the manufacturer gives him.

DAVID FERGUSSON:—There is another feature in regard to these tire sizes, and that is that 36″ by 4½″, 37″ by 5″ and 38″ by 5½″ all have the same seat diameter for the tire. So if a man wanted a bigger tire than 37 by 5 he would press his rim off and put the size larger tire on that same wheel whereas a 36″ by 5″ requires a new diameter of wheel, introducing another diameter of wood felloe. Our company has made a good many thousand cars with 37″ by 5″ tires. We know that is a good size for the 48-horsepower car. But we have no knowledge of the 36″ by 5″ tire; it may or may not be satisfactory for that weight car. The proposed 36″ by 5″ rim will take an oversize tire 37″ by 5½″. But that would be too big a tire for the front wheels. We would not get enough clearance between the tire and side steering rod. It is always an advantage to have a small cross-section tire for the front wheels to get good steering and also a better steering lock for turning in a small circle.

E. R. HALL:—In reference to the 36 by 5 tire not being tried out, there has always been a large number of 36 by 5 tires in use. They all fit a 36 by 5 rim, which, however, is the same in section as the 4½-inch rim. The tire has worked out very satisfactorily indeed, but the 37″ by 5½″, which is its oversize, is not a satisfactory tire on the rim. A new 36 by 5 tire to fit a new 5-inch rim of proper width will be a better tire in every way than the present 36 by 5 tire on the narrower rim which it is made to fit, and also better than the present 37 by 5 tire which is the oversize for the 36 by 4½. This new 36 by 5 tire and rim would also allow for satisfactory oversizing.

L. S. BOWERS:—Mr. Chairman, it seems to me that it is hardly a fair proposition for the Standards Committee or this meeting to consider the

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option which the user may have, since I think the major purpose in establishing tire sizes is to make them permanently standard; induce the manufacturers to apply those sizes to tires for certain determined loads; and as a natural consequence, the users will continue in the use of those tires. So, it seems to me that it is the purpose of the committee to determine for general weight, general loads, the most practical sizes of tires and to recommend that they be the standard sizes. This being the recommendation, of course the manufacturers will not depart from these sizes and then as a natural consequence, that standardization is eventually going to educate the users and buyers of tires so that they will continue to use those sizes.

Now, if this committee in its regard for the requirements, determine that the 36 by 5 or the 37 by 5 tire is the tire for certain loads, that should be adopted as a standard, without a consideration of the possibility of other sized tires which are to be used in the option of the buyer of the car only. I think we ought not to consider the allowance of options for the ultimate user of the car in our standardization work. Otherwise, we lose much of the merit of our work. If we cannot effect standards which will become absolute standards, subject, of course, to changes which experience may dictate, a large part of our effort fails. So, as I take it, the committee should consider these various suggestions for sizes of tires best adapted for certain character of load, and if it is decided that the 37 by 5 is the best sized tire for the load, let us make that our standard.

CHAIRMAN WALL:—We do not expect that everyone is going to adopt these standards immediately. At the same time we always want to get our standards as near right as possible, so that they will be used at least by the majority of the members. The oversized tire is at times of great advantage to the manufacturers, and at other times is a big nuisance.

Is there any further discussion?

G. L. MARKLAND, JR:—Why do we have standards with exceptions? The work of the Standards Committee is a pretty hard job. I do not know if the rest of us have considered all the possible features and details they are capable of devising, but it seems to me a standard should be a standard, and of course to have exceptions means there is no standard.

HENRY SOUTHER:—We are very glad indeed to get the suggestions that are made here. It is not a very serious thing for the committee to add three or four sizes, as suggested by this discussion.

There is only one more item that I want to point out and that is the unfortunate use of very large oversize tires on narrow rims. To make that perfectly clear to those who have not been fortunate enough to hear the discussion, it is like putting a great big soap bubble on a pipe. It tends to wobble and does. Therefore it rolls against the side of the rims, a rim of any form that may be used, and permits cutting and undue flexing of the fabric along the line of the bead or in that neighborhood. That is the unfortunate part of it and that is the reason

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that the Clincher Tire Association committee is looking seriously towards a new section of rim. The sections we have before us, I think four or five, have been in use for many years. The oversized tire on a narrow rim is very unfortunate; for the manufacturers, because it brings a good deal of complaint; for the user, because it brings a great deal of trouble.

This list of eight tire sizes will probably grow two or three before you next see it. What we are asking for today is acceptance by the Society of proposed methods of inspection of rims, which seem to be thoroughly good. That is the only part of the report that requires definite action, Mr. Chairman. The rest of it is report of progress.

CHAIRMAN WALL:—Gentlemen, you have heard what Mr. Souther has said in regard to this. What is your pleasure in regard to this report?

ORREL A. PARKER:—I move the adoption of the report.

(The motion was seconded, put to a vote and carried.)

HENRY HESS:—I would like to move that the committee be instructed to take into serious consideration in addition to the standard sizes, the 37 by 5 size.

CHAIRMAN WALL:—I think, Mr. Hess, that the committee will probably do that anyway without any formal motion.

MISCELLANEOUS DIVISION REPORT

DISCUSSION AT CAPE MAY

STANDARDS COMMITTEE MEETING

JOHN G. UTZ:—There was a misapprehension on the part of the spark plug makers, they thinking that we were going to cancel the old spark plug standard. We wish to correct that misapprehension by stating that we are offering an additional standard that merely has a bearing on the part of the plug above the thread. It seems that progress in the spark plug business has made it necessary to use larger porcelains. The present S. A. E. standard does not permit as large a porcelain as is desired in some cases, so the committee was requested to make an additional standard with a larger hex to allow for a larger porcelain.

In regard to the fit of the tapped hole, we sent a letter to the various tap and die manufacturers asking their opinion as to what tolerances should be allowed on taps, or on gages, preferably. We have a number of replies from which I believe we can outline a standard.

ROD AND YOKE END PINS

I am sure there will be no difficulty about the data regarding rod and yoke end pins. We made one or two small changes over what was originally suggested in the case of some of the larger pins, the size

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of the head, and the size of the bar stock from which the pin would be turned, being slightly decreased.

LICENSE PADS

The subject of license pads is growing. The longer we work at it the larger it gets. We have been sparring for an opening to get a start, and decided that we were trying to standardize about fifteen things at once. We have also decided that the best way to progress is to tackle one thing at a time. There is a letter prepared to be sent to the Secretary of State of each State in the Union, asking for a copy of the license law, and giving a general idea of what we desire to do. To start we shall try to standardize the height of the plate and the location of the attaching holes. If we start in that way, with the possible addition of the location of the license on the car and the illumination thereof, we will have made a considerable step in advance; and this seems to be the simplest thing to do. The additional things that we wish to standardize, such as the number of digits and the commutations and permutations of numbers that will give us a great enough list of numbers to cover the United States against a possible federal license, can follow the standardization of the size of the plate. The color schemes for the different years would be simple, once we had the plate size standardized. We hope to have more progress to report at a later meeting.

GASOLINE AND LUBRICATING OIL SPECIFICATIONS

The subject of gasoline and lubricating oil specifications is going to be a nice battle. I have been in touch with the Independent Petroleum Producers' Society in Cleveland and rather suspect that they are going to be as difficult as the Standard Oil. Mr. Platt, the editor of the Petroleum News, states that he is glad to notice that the Society is getting in touch with the independent producers in trying to lay out gasoline specifications. He took occasion to criticise the S. A. E. for the light engine lubricating oil specification which was drawn and submitted some time ago, stating that he had presented this specification to some practical oil men, who had reported that there was only one kind of crude oil from which that oil could be distilled, namely, Pennsylvania crude, which is on the decrease, and if the specification were rigidly adhered to we would soon have to quit driving cars because we could not get the oil. This is to give you an idea of some of the angles of the situation. We can only hope to progress gradually, but whether we will ever be able to arrive at a standard that will be acceptable to all parties concerned is an open question.

PITCH OF THREAD ABOVE 1½-INCH DIAMETER

The last item on our docket is one that we can make considerable progress in, and that is the extension of the S. A. E. standard thread for dimensions beyond an inch and a half diameter. We formulated a letter and circulated it among the car manufacturers, asking them to give us their tap sizes or their thread sizes for sizes above an inch and

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a half in diameter. The answers received are very close to what we want. One or two rather mis-read the letter and thought we were going to try to extend this standard to bolts and nuts; the idea being only to standardize the threads so that the car maker can purchase taps on the open market. We found specified in some replies diameters of threads running as high as eight inches. We found them in thousandths, sixty-fourths and all kinds of queer decimals. We found one company using eighteen threads per inch with the U. S. form on diameters above inch and a half, except on their trucks, where they used twelve on all sizes above inch and a half. We are trying to tabulate those returns with some idea of approaching a standard.

It would undoubtedly be a very fine thing if a standard could be established for the thread of such things as hub caps and spanner rings holding in bearings. It might possibly be one size thread, eighteen or some such figure.

CHAIRMAN SOUTHER:—Are there any thoughts along those lines? This is a report of progress only.

B. B. BACHMAN:—Mr. Chairman, in regard to standardizing these threads, it seems to me that there would probably be a field for standardizing more than one size thread; that is, I do not believe you could use one size for everything above one inch and a half. I think we have to give some consideration to service. We started out on the assumption that a sixteen thread on diameters above an inch and a half would probably give us the results that we required, and it has worked out on threads on hub caps and places of that sort. But there are other places, notably on the ends of wheel spindles, and on the end of the rear axle tubes for retaining the wheels and so forth, where we had to change those threads from sixteen to ten. We found ten to be a very suitable size for that particular service. We also think the characteristics of the material enter into the problem, as they have entered into the S. A. E. sizes below an inch now in force.

E. H. EHRMAN:—I think I can appreciate Mr. Bachman's position. In our shop we have followed out a scheme that I believe would answer his question. All taps of large diameter (by this is meant in the main larger than 1 inch) are made with the number of threads per inch increasing or decreasing arithmetically by a common difference of 4. In other words, the threads per inch are 8, 12, 16, 20, 24, 28, 32, 36 and 40. Eight and 12 threads are used where one or both parts are of cast iron; 12 and 16 threads for steel adjusting collars, etc., on spindles, shafts, etc.; 20 and 24 threads for tubing, smaller spindles, their fittings, etc.; 32 to 40 threads for smaller screw work, such as adjusting screws, light tubing, threads and similar work. By confining screw pitches to those given above, and eliminating the intermediate pitches, the number of taps and dies necessary is relatively small, and yet the selection is large enough to meet all ordinary shop conditions.

With reference to increasing the range of the S. A. E. bolt standard, I am interested in learning if there is any demand for sizes larger than

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1½ inches, especially on heavy truck work; not so much for the screws, however, as for the nuts. I can see that there might be occasion for the use of larger nuts to fit threaded rods and studs. It would be interesting to learn what the members think of the advisability of extending the present S. A. E. screw (and nut) standard.

This inquiry is prompted by the reply received from one of the largest automobile manufacturers to the letter sent out by the Society asking for information regarding the larger screw threads. This reply indicated that the screw standard has been extended beyond 1½ inches, the pitch remaining the same (12 threads per inch).

B. B. BACHMAN:—I was rather fearful, from Mr. Utz's remark, that they might be tempted to standardize all threads for over inch and a half to one pitch. I think that would not meet the requirements of the industry.

JOHN G. UTZ:—In answer to Mr. Bachman's question, I want to say first that at present we are merely gathering data to see where to run the line. We have a communication from the Packard Company which is quite interesting, inasmuch as it seems to cover the situation both ways. They have standards for nuts (not mentioning bolts) larger than an inch, up to two and a half inches, the S. A. E. standard form of thread, 12 to the inch; and in all other cases on the lists of their threads for standard dimensions, such as 1½, 1 9/16, 1⅝, and so on, they always have an 18 thread. Apparently the situation may direct itself towards two threads for each dimension above inch and a half; of course the fewer the better. There are times when a fine thread can be used, as on sheet metal; in other cases a coarse thread must be usd on account of other conditions.

SPEEDOMETER DRIVESHAFT ENDS

CHAIRMAN SOUTHER:—A bit of new business has come up, the question whether the end of the flexible shafting for speedometer drive should be referred to the Miscellanous Division for standardization. Complaint has come from axle builders and from car builders that the end of the speedometer shaft is as various as the number of speedometers, and something should be done with it; it is becoming a nuisance. Is it the desire of those present that that should be submitted for standardization? That is the question. Are there any remarks? Those in favor signify by saying "aye"; opposed, "no." It is a vote. It is a little thing, but it is little things that count.

SPARK PLUG FINGER FIT

JOHN G. UTZ:—It seemed the consensus of opinion that the spark plug should be different in its fit from an ordinary screw thread, having simply what is called a finger fit, being pulled down on its soft gasket with a wrench, and likewise broken loose with a wrench and unscrewed with the fingers. It will therefore be noticed when the prints appear that the pitch diameters are not consistent with the pitch diameters of ordinary threads, and the same can be said of the tap drills, for the reason mentioned.

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On the subject of the spark plug taps we wrote a number of tap manufacturers and obtained their ideas and then struck an average that seems to be very fair, particularly as it takes into account the tap drill recommended to be used ahead of the taps. The exact diameter of the 7/8 inch tap or bolt is .875. We are recommending an outside diameter of the taps—not the plug but the tap—of from .877 to .879. The exact pitch diameter is .839; we have recommended on the tap a pitch diameter of .841 to .843. We have recommended as a tap drill size .810 to .813. This looks like quite a large tap drill, but there are two very good reasons for it. The first is that it helps make the finger fit of the plug more of a sure thing. The other point is that the upper limit, .813, is a half a thousandth over a 13/16 drill, which makes it a commercial proposition, permitting the manufacturer to buy standard size drills. Sometimes they run a little over size, though if they came exactly to size, it would be within the limits recommended, permitting the use of that drill until it wears down to .0025 or .003 from the exact size.

That is all that the Division has to report at this time.

PRESIDENT LELAND:—Gentlemen, you have heard the report of the Miscellaneous Committee. Is there any discussion?

C. C. HINKLEY:—I would like to inquire why it would be necessary to create a new tap standard for the 7/8-18 spark plug? Why should it not be better to create an undersize thread spark plug and maintain the 7/8-18 standard pitch for the tap?

JOHN G. UTZ:—The recommended limits that we have placed on that tap are about an average of what the tap manufacturers are furnishing today for the 7/8-18. If anything we have drawn the limits a little bit closer than the tap manufacturers offer; but that in no way departs from what is commonly known as the 7/8-18 tap. It is merely defining the limits. I believe that such limits as may have been made previously were quite indefinite, as we as a committee were approached by the new combination or association of spark plug manufacturers requesting us to set limits that they could work to. Apparently the previous limits were hazy, or else there were none at all.

E. H. EHRMAN:—The pitch diameter of the spark plug thread was not specified in the old standard. The outside diameter was, the limits being from standard to .003" undersize. The pitch diameter of a perfect thread is a constant amount less than the outside diameter, consequently the pitch diameter would range from exact standard for an outside diameter of .875 to .003" smaller for an outside diameter .003" less. The outside diameter limits have not been disturbed.

As Mr. Utz says, our committee has compiled the data received in reply from inquiries sent out to the various tap manufacturers. These data indicate that the average tap ranges in pitch diameter from .001" oversize to .003" oversize, leaving a difference between the minimum tap pitch diameter, and the maximum spark plug pitch diameter of .001". That is, in a tap of minimum diameter there is only .001" wear before it becomes

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too small to tap a hole which will take a spark plug of maximum size. The pitch diameter dimensions have been definitely given instead of being implied as heretofore.

LOCK WASHER STANDARD

DISCUSSION AT CAPE MAY

STANDARDS COMMITTEE MEETING

CHAIRMAN SOUTHER:—The matter of lock washer standardization has been quiet for about two years and now comes up again in rather a curious way. Last winter the chairman of the Lock Washer Division stated that he had no report to make, that there were very few orders for lock washers outside of the Society of Automobile Engineers standard. I requested him at that time to make that statement in writing. About the middle of April I received word from him that an increasing number of people were not using the S. A. E. washer standard and that he could not understand it. In a recent letter the only explanation he offered was that he had one or two very large contracts from very large users of lock washers who did not, for some reason or other, specify S. A. E. lock washers. Are there any here who have any criticism to make of the S. A. E. standard?

C. W. MCKINLEY:—I have had a great deal of trouble with a lot of ¼ and 5/16 light duty lock washers; after screwing the nuts down the washers opened up, becoming oval and losing their holding power.

CHAIRMAN SOUTHER:—In other words, they were of too light cross-section?

C. W. MCKINLEY:—Yes.

CHAIRMAN SOUTHER:—How about the other section?

C. W. MCKINLEY:—The other section seemed to stand up pretty well, although it caused a great deal of cutting when it was disengaged, spoiled the surface.

CHAIRMAN SOUTHER:—Have you any suggestion as a remedy?

C. W. MCKINLEY:—None in particular, except in cases where that is objectionable, to use something different from the standard, a wider or a thinner lock washer. In my fittings I find that the heavy duty lock washer is very satisfactory.

CHAIRMAN SOUTHER:—The reason for there being two weights of lock washer is the fact that the light series is used with soft metals and the heavy series with harder metals. If the lighter series is too light for hard usage, that is what the heavy series is intended for. If, on the other hand, the lighter series is too light for any use, we ought to modify it. Have you any thought along that line?

C. W. MCKINLEY:—No, but I think the trouble is due to incorrect heat treatment of the washers.

CHAIRMAN SOUTHER:—What is the character of the trouble; drawing at too high a temperature, is it not?

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C. W. McKINLEY:—The trouble is very general in sizes below three-eighths in the light series.

CHAIRMAN SOUTHER:—The heavy series is all right?

C. W. McKINLEY:—Yes.

CHAIRMAN SOUTHER:—If there are no further remarks we will transmit the comments received here to the committee and have them go over the smaller sizes of the light series. This is the first criticism we have had of that design, and it may be, as stated, a question of materials and treatment rather than dimensions.

C. W. SPICER:—I think the last suggestion is perhaps right, but we use a great many three-eighths and five-sixteenths, and are having, by watching our source of supply carefully, very little trouble. We find that even against steel they stand being set down and loosened up several times, with no serious difficulty even in the light section. I have seen in some cars the use of a still lighter section, which absolutely was no good.

A. P. BRUSH:—Do the S. A. E. specifications on lock washers go into detail enough to suggest the tensile strength of steel and heat treatment of it?

CHAIRMAN SOUTHER:—The temper and toughness tests are very carefully brought out in the standard, as follows:

"Temper Test:—After compression to flat, reaction shall be sufficient to indicate necessary spring power and on a subsequent compression to flat the lock washer shall manifest no appreciable loss in reaction." That is, there will be no setting.

"Toughness:—Forty-five per cent. of the lock washer, including one end, shall be firmly secured in a vise, and 45 per cent., including the other end, shall be secured firmly between parallel jaws of a wrench. Movement of the wrench at right angle to helical curve shall twist the lock washer through 45 degrees without sign of fracture, and shall twist the lock washer entirely apart within 135 degrees." This is the limit for brittleness and the limit for toughness.

A. P. BRUSH:—I have known of trouble in some of the heavier series with brittleness, and I wondered if the S. A. E. had gone far enough to at least make a suggestion of some analysis and heat treatment which might perhaps help make them more uniform.

1914 TENNIS TOURNAMENT

The 1914 tennis tournament which was brought to a conclusion only recently, was won by Herbert Chase, J. E. Schipper contesting the singles championship with him in the finals, after having defeated David Beecroft, 6-4, 6-4 in the semi-finals. The score in the final match was 6-2, 6-2.

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NOMINATION OF OFFICERS

The 1914 Nominating Committee, consisting of R. H. Combs (*Chairman*), H. E. Coffin, C. W. Spicer, R. J. Nightingale and Herbert Chase (*Secretary*), has advised the office of the Society of the names of consenting nominees for the offices next falling vacant under the Constitution, as follows:

For President, William H. VanDervoort.

For First Vice-president, Frederick R. Hutton.

For Second Vice-president, Joseph A. Anglada.

For Treasurer, Arthur B. Cumner.

For Councilors.

C. B. Rose, 1915 and 1916.

John Wilkinson, 1915 and 1916.

William P. Kennedy, 1915 and 1916.

Frank M. Germane, 1915.

MEMBERS ELECTED DURING OCTOBER

MEMBERS

Anderson, Robert M., Stevens Institute of Technology, Hoboken, N. J.
Clarke, Alex. F., Firth-Sterling Steel Company, McKeesport, Pa.
Coleman, Clyde J., Premium Point Park, New Rochelle, N. Y.
Moore, Edgar D., American Electric Car Company, Saginaw, Mich.
Pagé, Victor W., 4 Arnold Court, Bristol, Conn.
Sackman, William H., 516 Grier Street, Williamsport, Pa.
Woodbury, A. C., 575 West 177th Street, New York City.

ASSOCIATES

Frewen, Thomas F., 7826 Kelly Street, Pittsburgh, Pa.
Martin, Frank H., 233 West 58th Street, New York City.
Murfey, S. L. Grant Lees Gear Company, Cleveland, Ohio.
Raseley, H. A., 9 Bridge Street, Sydney, N.S.W., Australia.

JUNIORS

Dick, Robert I., Dart Motor Truck Co., Waterloo, Iowa.
Taylor, William, Box 444, Walkerville, Ont.

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NOMENCLATURE DIVISION DISCONTINUED

At the last meeting of the Council it was decided that in view of the great amount of work involved in the determination of nomenclature of motor car elements and parts, and of the members of the Nomenclature Division not having the necessary time to go into the detail ramifications, the Division should be discontinued with thanks for what it has accomplished and the work be taken up at the office of the Society for the present.

It is the intention to prepare tentative classifications of parts covering groups entering into the construction of cars, for the purpose of submitting the same to specialists in and manufacturers of each group for criticism, the replies received to be compiled into final lists to be submitted to committees to be appointed later.

FITTING BALL BEARINGS

By F. J. Jarosch*
(Member of the Society)

Mr. A. Riebe in his paper entitled "Mounting of Ball Bearings," published in the S. A. E. Bulletin for October, 1913, gives tolerances for shaft diameters and ball bearing housings, for the purpose of recommending a proper press fit for the inner race and a sliding fit for the outer race. The figures given by Mr. Riebe allow very large limits, which if followed would, in my opinion, cause difficulties in mounting ball bearings upon the shaft, and, more important, the operation of ball bearings mounted in such a way would be seriously affected in practical service.

It is a well-known rule in the mounting of radial ball bearings that the inner race should have a tight fit on the shaft, while the outer race should be placed in the housing with a sliding or sucking fit. The principal reason for this rule is that in most cases the inner race is rotating, while the outer race is stationary in its housing; therefore a tight fit should prevent a movement between the inner race and the shaft, while the sliding or sucking fit of the outer race should allow the same to creep slowly and bring different parts of it under the zone of the load. A press fit always results in expansion of the inner race, and there is doubt as to what extent the inner race can be expanded without cracking it or straining the material too much, decreasing carrying capacity, or, a very vital point, pressing the balls tightly between the raceways. Such pressure on the balls results in an elastic deformation of them, and is very likely to expand the outer race also. A ball bearing operating under such conditions will be noisy and wear out quickly.

*Chief Engineer, J. S. Bretz Company.

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Considering these facts, the races have to be made of a material elastic enough to stand slight expansion without producing a strain in its structure, and the races and balls must be assembled with a slight radial shake in order to provide for the expansion of the inner race. There are, however, certain limits to these conditions. Practical experience has taught that the press fit—or, in other words, the expansion of the inner race—should not exceed .0005 inch to .001 inch, according to the size of the bearing.

Mr. Riebe stated that "the workmen grind the bore until the minimum mandrel will enter, which means the bore in most cases will be some thousandths of a millimeter below the standard size." Also, "our bearing is exact and always under the standard dimensions," that is, the bore is always a little minus but *never plus*. This is a common practice in ball bearing manufacture. Therefore, in making up mounting dimensions for shafts, or, in other words, limits for the tight fit of the inner race, only the minus limits actually used for the bore of ball bearings should be taken into consideration. I believe that it is not necessary to have a plus limit for grinding the bore of ball bearings, although some manufacturers claim such a limit is desirable in order to protect them, giving a wider range for possible errors in grinding. The plus limit of .0002 inch used by some of the ball bearing manufacturers should be abandoned in making press fit recommendations.

Mr. Riebe recommended in table No. 1 of his paper spindle diameters for press fit for inner races in millimeters. Converted into inches this table reads as follows:

Inner Race Diameter in Mm.	Bearing Numbers	Addition to Shaft Diameter in Inch	
		Minimum	Maximum
10 to 20	200 to 204, 300 to 304, 403 to 404	.0002	.0008
22 to 40	205 to 208, 305 to 308, 405 to 408	.0004	.0010
45 to 75	209 to 215, 309 to 315, 409 to 415	.0006	.0012
80 to 110	216 to 222, 316 to 322, 416 to 420	.0008	.0014

Considering the minus limit for bore given by Mr. Riebe, with .0004 inch added for all sizes of ball bearings, the following press fits will be obtained:

Inner Race Diameter in Mm.	Bearing Numbers	Press Fits Obtained from Table I, in Inch	
		Minimum	Maximum
10 to 20	200 to 204, 300 to 304, 403 to 404	.0006	.0012
22 to 40	205 to 208, 305 to 308, 405 to 408	.0008	.0014
45 to 75	209 to 215, 309 to 315, 409 to 415	.0010	.0016
80 to 110	216 to 222, 316 to 322, 416 to 420	.0012	0018

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As stated, a number of ball bearing manufacturers use no plus limit at all, that is, they specify a maximum minus limit of .0004 inch to .0007 inch, varying with the size of bore. In this case the press fit given above would be from .0001 inch to .0003 inch larger.

It is evident that such large press fits are not necessary to secure a good fit on the shaft, but would make it very difficult to mount the inner race. Furthermore, these press fits in many cases would cause a cracking of the inner race or jam the balls between the races, consequently expanding the outer race also. The radial shake will practically never run to such a total as will provide the necessary space for the expansion of the inner race under these conditions.

Following Mr. Riebe's ideas of press fit recommendations, the writer suggests the following limits for shaft diameter:

Inner Race Diameter in Mm.	Bearing Numbers	Addition to Shaft Diameter in Inch	
		Minimum	Maximum
10 to 20	200 to 204, 300 to 304, 403 to 404	.0	.0003
22 to 40	205 to 208, 305 to 308, 405 to 408	.0	.0004
45 to 75	209 to 215, 309 to 315, 409 to 415	.0	.0006
80 to 110	216 to 222, 316 to 322, 416 to 420	.0	.0008

These limits will always secure a tight enough fit of the inner race, as in most cases it is locked sideways.

In regard to the mounting of the outer race, which, as explained before, should have a sliding or sucking fit (piston fit) in the housing, Mr. Riebe's recommendation reads as follows:

Diameter of Outer Race in Mm.	Bearing Numbers	Tolerance for Inside Bore of Housing, in Inch	
		Plus	Minus
Up to 50	200 to 204, 300 to 303	.0004	.0
51 to 100	205 to 211, 304 to 309, 403 to 407	.0006	.0
101 to 150	212 to 217, 310 to 314, 408 to 412	.0008	.0
151 and larger	218 to 222, 315 to 322, 413 to 420	.0010	.0

The diameter of the outer race is ground from standard to a minus limit, and will therefore be always minus but never plus. Considering the limits for outer diameter as adopted by the S. A. E., Mr. Riebe's recommendation gives the following figures for piston fits:

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Diameter of Outer Race in Mm.	Bearing Numbers	Clearance Between Outer Race and Housing, in Inch	
		Minimum	Maximum
Up to 50	200 to 204, 300 to 303	.0004	.0010
51 to 100	205 to 211, 304 to 309, 403 to 407	.0006	.0014
101 to 150	212 to 217, 310 to 314, 408 to 412	.0008	.0016
151 and larger	218 to 222, 315 to 322, 413 to 420	.0010	.0022

The outer race should never have a press fit in the housing, but it is just as bad to go to the opposite extreme and have the fit too loose. It may be important to call attention to a fact learned in practical experience, viz., that the outer race of ball bearings is hardened steel, while the housings are usually cast iron, of much softer material; consequently, the outer race will pound the material of the housings and work loose after operating under load. Vibrations of the shaft and bearing will naturally increase the tendency of the bearing to work loose. Of course, it may be considered that the actual minus limits used by some manufacturers of ball bearings are smaller than the standard limits adopted by the S. A. E. Since the S. A. E. tolerances for outer race diameter are very large, and there is considerable difference in the limits actually used by the ball bearing makers, it is quite difficult to recommend positive figures from which to obtain a proper sliding fit for the outer race in its housing. The best way, naturally, would be to fit every individual ball bearing in its housing, but in order to insure interchangeability, the writer believes a sufficiently loose fit will be obtained if the bore in the housing be made from .0003 inch to .0006 inch larger than the standard outside diameter of the bearing.

Meetings Committee Rules as to Papers

(*Revised October, 1914*)

1. Securing and approval of papers for presentation at meetings of the Society are within the jurisdiction of the Meetings Committee.
2. The right is reserved to edit accepted manuscripts of authors as to style and form and as to substance where the last named is deemed objectionable.
3. Papers are accepted upon the express understanding that the authors thereof will be on hand promptly at the time of the Society meeting scheduled for presentation of the same.

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4. Authors will be advised in due course of the rejection or acceptance of papers in modified form or otherwise.
5. Accepted papers become the property of the Society.
6. All manuscripts shall be typewritten on one side of the paper with wide space between lines (preferably triple space) and at the edges, and must be furnished in duplicate. Authors are requested to furnish six copies of manuscripts for the use of the Meetings Committee, if feasible.
7. All illustrations and tabular matter must be suitable for reproduction in printed form. Authors are requested to furnish first-class tracings of drawings with lettering and figuring thereon large enough to be plainly legible when necessary reduction of plate size is made. It is requested that blueprints of tracings and extra copies of photographs be furnished for use with the above-mentioned extra copies of manuscript.
8. Authors are asked to place numerous sub-headings in their manuscripts.
9. The Society reserves the right of prior publication of all papers. Authors will upon request be furnished with twenty complimentary copies of papers and can purchase additional copies of the same from the Society at a figure which will be named upon request. Reprints of papers must be identical in form as published by the Society, without addition or omission and without ornamental covers, etc.
10. Papers accepted for presentation at Society meetings are almost invariably printed in advance in the monthly Bulletin.
11. Promptly upon publication copies of papers are furnished to the exchange list of the Society, which is extensive.
12. The inclusion of papers in the Transactions of the Society is determined by the Publication Committee.
13. No trade names shall appear on plates or slides presented in connection with papers, for other than reference purposes.
14. No matter not appearing in a paper as edited by the Society shall be presented at a meeting of the Society, when the said additional matter is in the discretion of the presiding officer of the meeting considered as advertising.
15. Manuscripts of papers must be submitted by authors thirty days in advance of the meeting for presentation at which the manuscripts are submitted.

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REVISED BY-LAWS AND RULES

BY-LAWS

CANDIDATES FOR MEMBERSHIP

B1—A candidate for admission to the Society as a Member, Associate or Junior must make application on a form approved by the Council, upon which he shall write a statement giving a complete account of his qualifications and engineering or other required experience, and an agreement that he will, if elected, conform to the Constitution, By-Laws and Rules of the Society. He shall refer to at least five Members, Associates or Juniors with whom he is acquainted.

B2—Applications for admission to the Society from persons who are not resident in the United States or Canada, or who may be so situated as not to be personally known to five Members, Associates or Juniors of the Society, as required in the foregoing paragraph, may be elected by the Council, after sufficient evidence has been secured to show that in its opinion the applicant is eligible for admission to the respective grade.

B3—References shall not be required of candidates for Honorary, Departmental or Affiliate Membership.

B4—The references for each candidate for admission to the Society or student enrollment may be requested to make confidential communication setting forth in detail such information, personally had by them, as will enable the Council to arrive at a proper estimate of eligibility of the candidate.

B5—Each applicant for student enrollment shall be endorsed by a member of the Society and approved by the Council. Student enrollment shall be revocable at the pleasure of the Council. Enrolled students shall receive the regular monthly publication and may attend meetings of the Society.

B6—The Secretary shall present to the Council at each meeting, applications of candidates for membership in the Society, except in the case of Honorary Members. He shall announce to the candidates the result of the application.

The name of an applicant for membership must be printed in at least one issue of a publication of the Society, prior to election.

B7—The references of an applicant who has failed of election may, with his consent, present to the Council a written request for a resubmission of his name. The Council may, in its discretion, by a three-fourths vote of the members present, order the name of the applicant resubmitted for election.

B8—Election to Honorary Membership shall be by letter ballot of the Council. A notice of such proposed election shall be mailed by the Secretary to each member of the Council at least sixty days in advance of the date set for the closure of such election.

ELECTION OF OFFICERS

B9—The Secretary shall mail to each member entitled to vote, at least

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thirty days before the Annual Meeting, the names of the candidates for office proposed for election by the Nominating Committee or Committees.

B10—The names of the candidates proposed by the Nominating Committee or Committees, and the respective offices for which they are candidates, shall be printed in separate lists on the same ballot sheet, each list of candidates to be printed under the names of the members of the particular committee which proposed it.

B11—The name of any candidate on the ballot may be erased and the name of any person qualified to hold the office written in its stead. The voter shall enclose said ballot in a sealed blank ballot envelope which he shall then enclose in a second sealed outer envelope on which he shall, for identification, write his name in ink. The ballot thus prepared and enclosed shall be mailed or delivered unopened to the Tellers of Election of Officers. The Secretary shall certify to the competency and the signature of all voters.

The Tellers shall not receive any ballot after the stated time of closure of voting. A ballot without the endorsement of the voter written in ink on the outer envelope is defective and shall be rejected by the Tellers. At the first session of the Annual meeting the Tellers shall first open and destroy the outer envelopes and then canvass the ballots and certify the result to the meeting of the Society.

B12—In case of a tie in the vote for any officer, the President or, in his absence, the presiding officer, shall cast the deciding vote.

B13—A ballot which contains more names marked by a cross on it than there are officers to be elected, is thereby defective, and shall be rejected by the Tellers.

FEES AND DUES

B14—The initiation fee and the current annual dues of the first year shall be due and payable on notice of election to membership, and upon the payment the member will be entitled to the Society's publications for the year. Thereafter the annual dues shall be due and payable on the first day of October in each year.

The annual dues for Student Enrollment shall be due and payable upon notice of enrollment.

The initiation fee for Departmental Member shall be due and payable upon notice of election and upon such payment such member will be entitled to the Society's current publications.

B15—A Member in arrears for three months shall not be entitled to vote until such arrears have been paid. Should the right to vote be questioned, the books of the Society shall be conclusive evidence.

B16—The Secretary shall present to the Council the name of any Member, Associate, Junior or Affiliate Member in arrears for more than three months, and such member shall not receive the publications of the Society until such arrears are fully paid. A person dropped from the rolls for nonpayment of dues may at the discretion of the Council be restored to the privileges of membership, upon payment of all arrears.

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FINANCIAL ADMINISTRATION.

B17—The Council shall each year consider the recommendations of the Finance Committee concerning the expenditures necessary for the work of the Society during each coming fiscal year. The apportioning of the work of the Society among the various administrative and other committees shall be on a basis approved by the Council and in harmony with the Constitution and By-Laws. The appropriations approved by the Council, or so much thereof as may be required for the work of the Society, shall be expended by the Secretary acting as General Manager, under the direction of the various committees of the Society, and all bills against the Society for such expenditure shall be certified by the Secretary and shall then be sent to the Finance Committee monthly for approval. Money shall not be paid out by any officer or employee of the Society except upon vouchers duly audited or authorized by the Finance Committee or the Council.

FINANCE COMMITTEE

B18—The Finance Committee shall, under the direction of the Council, have supervision of the financial affairs of the Society, including the books of account. The Committee may cause the accounts of the Society to be audited and approved annually by a chartered or other competent public accountant. The Committee shall make recommendations to the Council as to investments, and, when called upon by the Council, advise upon financial questions.

MEETINGS COMMITTEE

B19—It shall be the duty of the Meetings Committee to procure professional papers, pass upon their suitability for presentation, and suggest topical subjects for discussion at the meetings. The Committee may refer any paper presented to the Society to a person or persons especially qualified by theoretical knowledge or practical experience for suggestion or opinion as to the suitability of the paper for presentation. Papers from non-members shall not be accepted except by unanimous vote of the Committee.

The Committee shall arrange the program of each meeting of the Society, and have general charge of the entertainments to be provided for the members and guests at each meeting. It shall prohibit the distribution or the exhibition for other than reference purposes of all advertising circulars or trade literature at the headquarters or at the meeting place of the Society.

PUBLICATION COMMITTEE

B20—The Publication Committee shall review all papers and discussions which have been presented at the meetings of the Society or its Sections, and decide what papers or discussions, or parts of the same shall be printed in the publications of the Society and what shall be omitted. The Committee will be expected to publish all such data as will be of assistance to engineers or investigators in their work.

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MEMBERSHIP COMMITTEE

B21—It shall be the duty of the Membership Committee to devise and to carry into effect, with the approval of the Council, ways and means for increasing the membership of the Society in accordance with the provisions of the Constitution as to the qualifications for membership.

HOUSE COMMITTEE

B22—It shall be the duty of the House Committee to have the care, management and maintenance of the rooms of the Society and its furnishings.

EXECUTIVE COMMITTEE

B23—The Executive Committee, if appointed by the Council, shall make a report of its acts at each session of the Council, for approval. The Secretary may take part in the deliberations of the Executive Committee, but shall not have a vote therein.

NOMINATING COMMITTEES

B24—It shall be the duty of the Nominating Committee to organize at the summer meeting of the Society and to send to the Secretary, on or before October 1st, the names of consenting nominees for the elective offices next falling vacant under the Constitution. The report of the Committee shall be printed in the next current publication of the Society.

B25—A special Nominating Committee, if organized, shall, on or before November 15th, present to the Secretary the names of the candidates nominated by it for the elective offices next falling vacant under the Constitution, together with the written consent of each. The report of the Committee shall be printed in the next current publication of the Society.

SOCIETY DELEGATES

B26—The Council, may, in its discretion, appoint a member or members of any grade of the Society, or other person or persons, to represent it at meetings of societies of kindred aim or at public functions. The duties of such delegates shall terminate with the occasion for which they were appointed.

TELLERS

B27—The presiding officer shall, at the first session of the Annual Meeting, appoint three Tellers of Election of Officers, whose duties shall be to canvass the votes cast, and report the result to the meeting. Their term of office shall terminate when their report of the canvass is presented to the meeting.

B28—The President shall appoint three Tellers to canvass any letter ballots which shall be ordered by the Council or by the Society.

MEETINGS

B29—The Annual Meeting of the Society shall be the first regular meet-

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ing of the calendar year, and the Semi-Annual Meeting shall be the second regular meeting of the calendar year. The business session of the Annual and of the Semi-Annual Meeting shall be the first session of each such meeting.

Notice of the Annual and Semi-Annual Meetings of the Society shall be printed in a publication of the Society not less than thirty days before the date or dates of each such meeting.

SECRETARY

B30—The Secretary of the Society shall be the Secretary of the Council.

The Secretary shall, under the supervision of the Finance Committee, have charge of the books of account of the Society; shall make and collect all bills against members or others; shall have charge of all bills against the Society, and shall keep an account of the same, and present them in proper form to the Finance Committee for approval.

All funds received by any person for the Society shall be delivered to the Secretary, who shall immediately enter them in the books of account, and deposit such funds as he receives to the credit of the Society, in a bank to be designated by the Council.

TREASURER

B31—The Treasurer shall make payments only upon the approval of the Finance Committee, or upon the direction of the Council by resolution. He shall furnish a bond for the faithful performance of his duties to such amount as the Council may require, such bond to be procured from an incorporated guarantee company, at the expense of the Society.

CERTIFICATES

B32—Each Member, Associate, Junior, Departmental Member and Affiliate Member shall, subject to such rules as the Council may establish, be entitled to a certificate of membership, signed by the President and Secretary of the Society. Every such certificate shall remain the property of the Society and be returned to it on demand of the Council.

PROXIES

B33—Each proxy authorizing a voting member to vote for an absent Member, shall be signed by such absent Member, with an attesting witness, and be submitted to the Secretary for verification of the Member's right to vote at the meeting at which the right is to be exercised.

EMBLEMS

B34—The emblem of each grade of membership approved by the Council shall be worn by those only who belong to that grade. The official stationery shall be used only by Officers and Committees of the Society.

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TITLES

B35—The approved abbreviations of the title of the various grades of membership are as follows:

For Honorary Members	Hon. M.S.A.E.
For Members	M.S.A.E.
For Associates	A.S.A.E.
For Juniors	Jun. S.A.E.
For Departmental Members	Depart'l Mem. S.A.E.
For Affiliate Members	Affil. Mem. S.A.E.

RULES

R1—The Secretary's office shall be open on business week days from 9 A.M. to 5 P.M.; on business Saturdays from 9 A.M. to 1 P.M.

R2—The Secretary shall provide an identification badge or pin for each member or guest attending the regular meetings. A register shall be kept for each regular meeting, to record the attendance of members and guests.

ORAL DISCUSSION

R3—Each person shall be limited to five minutes in the oral discussion of a paper, unless the time be extended by unanimous consent. A person who has once had the floor may not claim it again until all the others who desire to speak on the subject under discussion have been heard. Authors shall have not less than five minutes to close discussion on their papers.

PAPERS

R4—The Meetings Committee shall deliver to the Secretary all papers it recommends for presentation at the professional sessions of the Society meetings in time to permit the printing and distribution of the papers in advance of the meetings.

R5—The Secretary shall have sole possession of papers and illustrations between the time of their approval by the Meetings Committee and their presentation at the professional sessions of the Society.

R6—So far as feasible or necessary, a copy of the reported discussion shall be sent to each member who presented it, with the request that he correct errors or omissions and return the same promptly to the Secretary.

R7—Members may order reprints of papers from the Society, provided that such copies are not to be resold.

R8—The Secretary may furnish each author twenty copies of his paper without charge. He may also furnish to the press copies of papers in advance of or after meetings.

LOCAL COMMITTEE

R9—The entertainment to be provided for the members and guests at any meeting of the Society in any city may be in charge of a Local Com-

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mittee, subject, however, to the general approval of the Meetings Committee.

R10—A member of any grade may invite a non-member to the professional sessions of any regular meeting of the Society, except in case of a special ruling by the Council. Such invited guest shall not take part in any discussion without the permission of the presiding officer. Invitations to guests of members for entertainments provided for the Society shall be in the discretion of the Local Committee.

CHANGES OF ADDRESS OF S.A.E. MEMBERS

Brainard, George C., formerly engineer, Roger B. McMullen, Detroit, Michigan; now in sales and engineering departments, Hydraulic Pressed Steel Company, Cleveland, Ohio.

Braun, Theo. C., now laboratory assistant, Platt & Washburn Mfg. Company, Bayonne, N. J.

Charters, D. B., formerly mechanical engineer, Model Gas Engine Works, Peru, Ind.; now engineer, Pittsburgh Model Engine Co., Pittsburgh, Pa.

Clement, Carl H., formerly chief engineer and sales manager, Metal Products Company, Detroit, Michigan; now sales engineer, Bock Bearing Company, Toledo, Ohio.

Douglas, S. A., formerly special factory representative, Jones Speedometer Company, New York City; now special factory representative, Stewart-Warner Speedometer Corp., Chicago, Illinois.

Greenburg, Alfred A., formerly sales manager, Baltimore Tube Company, Baltimore, Maryland; now sales manager, The Kosmath Company, Detroit, Michigan.

Hatch, Darwin S., formerly technical editor, Class Journal Publishing Company, Chicago, Illinois; now managing editor, Light Car Publishing Company, Detroit, Michigan.

Hubbard, Floyd B., formerly motor designer, Buda Company, Harvey, Illinois; now connected with Saxon Motor Company, Detroit, Michigan.

Jackson, P. Edmund, formerly manager, Jackson Radiator Company, Detroit, Michigan; now sales engineer, Fedders Mfg. Company, Detroit, Michigan.

Lowy, Emil M., formerly mechanical engineer and technical representative, Olin Giberson & Lowy, New York City; now president, Riebe Ball Bearing Company, New York City; also secretary and treasurer, Magneto Parts Company, New York City.

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McCulla, Wm. R., formerly assistant research engineer, Packard Motor Car Company, Detroit, Michigan; now assistant chief engineer, Knox Motors Company, Springfield, Mass.

Ranger, Karl F., formerly checker, Chase Motor Truck Company, Syracuse, N. Y.; now connected with Chalmers Motor Company, Detroit, Michigan.

Stickles, E. H., formerly sales manager, Sunderman Safety Carbureter Corp., Newburgh, N. Y.; now president, Holt-Welles Co., Inc., New York City.

Szekely, O. E., now connected with the Velie Motor Vehicle Company, Moline, Illinois.

Trego, Frank H., formerly research engineer, Packard Motor Car Company, Detroit, Michigan; now assistant general manager, Knox Motors Company, Springfield, Mass.

Vincent, C. H., formerly manager, Hudson Motor Car Company, San Francisco, Cal.; now experimental engineer, Ferro Machine & Foundry Company, Cleveland, Ohio.

Wade, Chas. E., formerly connected with Chas. E. Wade Sales Company, Detroit, Michigan; now manager of sales, Anderson Forge & Machine Company, Detroit, Michigan.

Webster, D. B., formerly experimental engineer, Hudson Motor Car Company, Detroit, Michigan; now connected with National Motor Vehicle Company, Indianapolis, Ind.

APPLICATIONS FOR MEMBERSHIP

A list of current applications for membership is given below. The members are urged to send for the consideration of the Council any pertinent information with regard to those whose names are given which the Council should have prior to the election of any of the said applicants. It is requested that communications from the members in this connection should be sent promptly.

Batenburg, P., Chief Engineer, Four-Wheel Drive Auto Company, Clintonville, Wis.

Bull, Arthur A., Designer, Engineering Department, Northway Motor & Manufacturing Company, Detroit, Mich.

Delay, Christian, Draftsman, Geneva, Switzerland.

Drake, J. Walter, President, Hupp Motor Car Company, Detroit, Mich.

Fielder, R. E., Chief Draftsman, Fifth Avenue Coach Company, New York City.

Harley, Wm. S., Engineer, Secretary and Treasurer, Harley-Davidson Motor Company, Milwaukee, Wis.

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Lane, Theodore Thomas, Production and Service Engineer, Wichita Falls Motor Company, Wichita Falls, Tex.

Langton, Chas. R., Manager, Kansas City Branch, Kelly-Springfield Motor Truck Company, Kansas City, Mo.

Massey, Hemsley B., Draftsman, H. H. Franklin Manufacturing Company, Syracuse, N. Y.

Menderson, Edgar, Laboratory Engineer, Dodge Brothers, Detroit, Mich.

Moore, M. LaBarre, Sales Manager, American Developing & Sales Company, New York City.

Nagel, William G., President and Manager, W. G. Nagel Electric Company, Toledo, Ohio.

Parker, Willard, Vice-president and General Manager, Pennsylvania Shafting Company, Spring City, Pa.

Pollitt, John, Jr., Manager, Repairs Department, John Pollitt, Liverpool, England.

Russel, Philip S., Manager, Buick Motor Company, Philadelphia, Pa.

Ryan, Dan J., President and General Manager, Allyne-Ryan Foundry Company, Cleveland, Ohio.

Shepard, Edward M., Engineer, Wagner Electric Manufacturing Company, Detroit, Mich.

Wahl, G. Adolph, Designing Engineer, Lyons-Atlas Company, Indianapolis, Ind.

White, Charles M., Jr., Manager, Detroit Branch, Stromberg Motor Devices Company, Chicago, Ill.

Wright, M. H., Mechanical Superintendent, Pennsylvania Shafting Company, Spring City, Pa.

Young, Otto W., Draftsman and Designer, H. E. Wilcox Motor Company, Minneapolis, Minn.

POSITIONS AVAILABLE

The following announcements are published for the information of members of the Society. No charge whatever is made for these announcements. Members who wish additional information will please address the office of the Society:

*167. Salesman, one that is capable of managing sales department, familiar with the automobile trade and of pleasing personality.

169. A high-grade retail salesman of moderate-priced pleasure cars for New York City proper.

*179. Expert final chassis tester and motor expert, on commercial work.

---

*Send written application to S. A. E. office to be forwarded to employer.

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189. Foundry foreman; one who can handle men and knows foundry business, especially in the cast-iron line.

190. Experienced production man for a light four-cylinder car.

195. Electrical engineer to take complete charge of electrical end of the automobile, in experimental stage as well as in production.

196. Vacancy for an assistant sales manager. Must be a technical graduate in either mechanical or electrical engineering. One who has been a success as an engineer as well as associated in the sales end of some good live organization. Must be able to satisfy us as to his ability as both a salesman and an engineer. We prefer one who is at present employed with a live wire concern. Salary $3,000 to $4,000.

*197. Young man of pleasant personality, with knowledge of repair and garage work. Able to express himself well and to handle mechanics properly in a factory garage. Opportunity for advancement in salary and responsibility as rapid as merited.

198. First-class draftsman for automobile factory in New England. Salary $25-$30.

MEN AVAILABLE

0275. Man with seven years' drafting experience on pleasure cars and electric starter work wishes to take charge or assist in establishing a drafting room system which turns out excellent drawing in minimum time.

0276. Service manager or engineer with excellent executive and engineering ability. Experienced in truck and pleasure car manufacture, design, repair and shop practice. Wide mechanical experience. Used to handling men and assuming responsibility. Good correspondent. Married. Age thirty-four. Western location preferred.

0277. Engineer, mechanical and electrical. Capable and energetic, with excellent executive ability. Exceptionally good practical experience on both trucks and pleasure cars in engineering, designing, purchasing, shop practice, construction and production. Especially competent on electric systems. Able to handle men and fully capable of assuming responsibility. Married. Age thirty-three. Salary moderate.

0278. Salesman with electrical and mechanical engineering experience; for the past four years selling an accessory to the motor manufacturers in the United States, Canada and Europe.

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*Send written application to S. A. E. office to be forwarded to employer.

(*Continued*)

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OFFICERS OF THE SOCIETY

President, Henry M. Leland, Detroit, Michigan.

Vice-president, William Guy Wall, Indianapolis, Indiana.

Vice-president, K. W. Zimmerschied, Detroit, Michigan.

Treasurer, Hermann F. Cuntz, New York.

Chairman of Finance Committee, H. M. Swetland, New York.

Secretary and General Manager, Coker F. Clarkson, New York.

MEMBERS OF THE COUNCIL

Henry M. Leland, Detroit, Mich.

William Guy Wall, Indianapolis, Ind.

K. W. Zimmerschied, Detroit, Mich.

Hermann F. Cuntz, New York.

Joseph A. Anglada, New York.

Harold L. Pope, Cleveland, O.

E. F. Russell, Longmeadow, Mass.

Christian Girl, Cleveland, Ohio.

Henry C. Wilson, New York.

Walter C. Baker, Cleveland, Ohio.

H. W. Alden, Detroit, Mich. (Past President).

Howard Marmon, Indianapolis, Ind. (Past President).

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SECTIONS OF THE SOCIETY

DETROIT SECTION

E. T. BIRDSALL.....*Chairman*
C. T. MYERS and W. N. OSBURN.....*Vice-Chairmen*
HERBERT L. CONNELL.....*Secretary and Treasurer*

(Address) 109 Webb Avenue, Detroit, Mich.

Meets first Thursday each month at 8 p. m., in the Employers' Association Rooms, Stevens Building, Detroit, Mich.

INDIANA SECTION

LON R. SMITH.....*Chairman*
R. H. COMBS.....*Vice-Chairman*
CHAS. P. GRIMES.....*Secretary-Treasurer*

(Address) Wheeler & Schebler, Indianapolis, Ind.

Meets first Tuesday after first Wednesday each month at 8 p. m., at the Hoosier Motor Club in the Claypool Hotel, Indianapolis, Ind.

METROPOLITAN SECTION

JOSEPH A. ANGLADA.....*Chairman*
HERBERT CHASE.....*Treasurer*
N. B. POPE.....*Secretary*

(Address) 1790 Broadway, New York City.

Meets last Thursday each month, except July and August, 8 p. m., at the Automobile Club of America, 247 West Fifty-fourth Street, New York City.

CLEVELAND SECTION

JAMES H. HERRON.....*Chairman*
H. B. ANDERSON.....*Vice-Chairman*
A. J. SCAIFE.....*Treasurer*
R. J. NIGHTINGALE.....*Secretary*
E. R. HALL, J. H. HERTNER, R. H. MANSON } ..... *Members Board of Directors*

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The War and Ball Bearings

THE war has undoubtedly affected the delivery to American users of Ball Bearings who have long been well cared for by the importers of ball bearings.

F & S BALL BEARINGS have always competed, in a good-natured business way, with all other ball bearing makers, domestic and foreign, in a public-spirited effort to push quality and quantity, but always with an obvious desire to place the output on the highest plane of mechanical excellency and standardization.

MOREOVER, we are aware that during the last three months, purchasing connections of years have been disrupted. To the users of ball bearings who are in this unfortunate class, we can be of great help, and we will be pleased to take up the use of **F & S** Ball Bearings with them, if they will only tell us their needs and wants. Correspondence and inquiry along this line is solicited, with the hope that our best efforts and immense resources may be immediately available to relieve at once these unfortunate conditions prevailing in the ball bearing field.

J. BRETZ COMPANY
SOLE IMPORTERS
F & S Ball Bearings
250 West Fifty-fourth, New York

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ANNOUNCEMENT

Introducing the

Browne Carbureter

The Browne carbureter was designed and patented by Mr. Arthur B. Browne, A.I.M.E., S.A.E., Consulting Engineer of the Malleable Iron Fittings Company, Branford, Conn.

The papers presented to the Society of Automobile Engineers by Mr. Browne on "Problems of Carburetion," etc., are evidence of much detailed study and research into the highly complex and somewhat obscure laws governing carburetion.

The Browne differs materially from other devices in that it operates throughout its entire range on one comprehensive principle and maintains a constant and uniform mixture under all speed or load conditions, independent of barometric changes.

Owing to the principle on which the Browne operates, the instrument is made in but one size, with one adjustment only—the needle valve—which will serve any size or type of gasoline engine, from the smallest single cylinder, two cycle, motor boat engine, to the largest six cylinder, four cycle, automobile engine in common use.

For over three years large numbers of the Browne carbureters have been in constant use on motors of varying sizes and types, under all conditions of climate, altitude and weather, as well as for all purposes, having been given the same handling and attention to which all carbureters are subjected in actual use.

Results based upon service, road and shop tests, and many comparative tests in laboratories, have been made in such numbers as to leave no doubt of the sustained superiority of the Browne in the qualities so urgently desired and actively sought by all engineers and manufacturers.

Now, for the first time, the Browne carbureter is presented to the engineering world, and offered to the public, with full knowledge that it will meet all conditions and requirements of greater efficiency, economy and simplicity in the operation of the internal combustion engine than are attainable under present conditions.

The controlling forces or factors in the Browne are velocities, which are calculated by an application of the law of gravity, and are as unchangeable as the law of gravity itself.

This principle has been incorporated into the details of the instrument, made part of it, and unchangeable, making the carbureter actually incapable of inaccuracy.

Fullest investigation and tests are urged upon all who would welcome results they believe not now attainable.

(See second page following)

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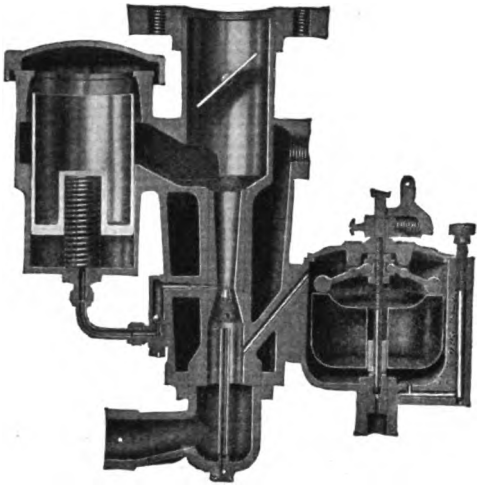

Owing to the comprehensive principle on which the Browne operates, the instrument is made in but one size, with one adjustment only—the needle valve—which will serve any size or type of gasoline engine, from the smallest single cylinder, two cycle, motor boat engine, to the largest six cylinder, four cycle, automobile engine in common use.

N. B.—Aware of the radical nature of this statement; that it describes the hitherto impossible, nevertheless it is made without reservation.

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Next to the proven superiority of the Browne carbureter, is the assurance that back of it are a factory and an organization which for more than half a century have been recognized as of the best and largest in New England, with an equipment offering unlimited facilities for the production of carbureters of the highest standard of material and workmanship.

Limitations of space prevent a complete description of the Browne carbureter in these pages.

Full information will be sent free, without obligation, to all who request it.

Malleable Iron Fittings Co., Branford, Conn.

Malleable Iron Fittings Company are Manufacturers of Browne Carbureters

SOLE SELLING AGENTS:

Holt-Welles Company, Inc.

E. H. Stickels, President

U. S. Rubber Building

1790 Broadway

New York

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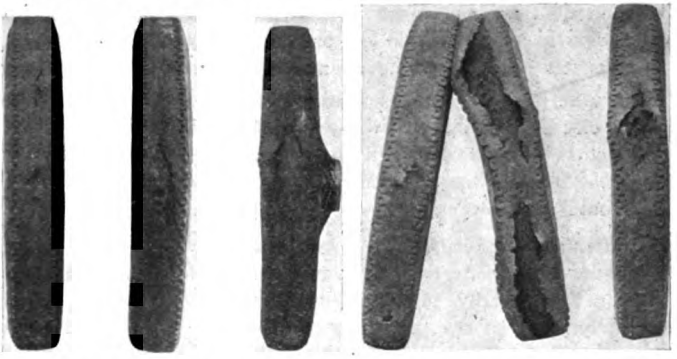
Wood Wheels Showed Greater Average Tire Mileage

than wire wheels in the Automobile Club of America's official test of tires on wood and on wire wheels.

It was a Wood Wheel, too, That Gave the Greatest

individual mileage, going 10,164 miles with one tire, as against 9,220 miles, the best performance of any of the wire wheels.

HERE ARE PICTURES OF THE FINISHING TIRES



WOODEN WHEELS		WIRE WHEEL	WOODEN WHEELS		WIRE WHEEL
B31703	B49639	B49685	B40989	B36727	B40666
Right Rear	Left Rear	Right Front	Left Front	Right Front	Left Front
7500 Miles	5700 Miles	6530 Miles	8940 Miles	10164 Miles	9220 Miles
Blowout	Worn out	Blowout	Blowout	Worn out	Blowout

The average life of the tires on Wire Wheels was - - - - - 6,470 miles

The average life of the tires on WOOD WHEELS was - - - - - 8,076 miles

For full particulars of this test see Bulletin of the Automobile Club of America Testing Laboratory for August, 1914.

There is no mystery about WOOD WHEEL SUPERIORITY!

Hayes Wheel Company

Jackson, Michigan

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(Continued)

0279. Pioneer automobile engineer and executive who has a very wide and accurate knowledge of pleasure car and truck engineering and business conditions in this country and abroad, would consider engagement on a basis commensurate with his previous work and success. Development work in the East preferred.

0280. Engine designer, competent to take charge of drafting room, design of complete car or experimental work. Ten years' experience.

0281. Chief engineer of prominent motor truck company, having just completed designs for full line of latest type trucks, is open for engagement.

0282. Chief engineer and designer in buildings, transportation, tools and construction. Long and valuable experience. Has specialized in indoor (warehouse) trucks.

0283. Production superintendent or assistant engineer; man who can design in consideration of present-day quantity production requirements and produce quantities at reduced cost.

0284. Engineer and designer; seventeen years' European experience on all classes of vehicles, from light pleasure cars to heavy trucks, tractors and gasoline rail cars. Has studied necessities of design, from extensive road and repair department experience. Would consider sales or service end of business.

0285. Draftsman of executive ability with seven years' broad experience in the automobile line as layout man, designer and chief draftsman. Especially good on economical production. American, thirty years of age.

0286. Young man with four years' practical experience with motor car manufacturers. At present employed as designer and chief engineer. Desires position with large manufacturer. Has held positions in office, purchasing, drafting, laboratories and engineering departments.

0287. Engineer just returned from England desires position as engineer, chief draftsman or designing engineer. Ten years' experience.

0288. Young man, twenty-seven, eleven years' experience with foreign and American high-class cars. Expert on all classes of work. Excellent producer. Wishes to locate with progressive concern manufacturing either pleasure or commercial cars.

0289. Worker with ambition and push, getting results now as for years back, wants to exchange his experience and ambition for a nominal salary and a good chance to get ahead. Years of experience as superintendent, factory manager and purchasing agent.

(Concluded)

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HESS-BRIGHT LITIGATION

HESS-BRIGHT PATENT BROADLY SUSTAINED IN ACTION AGAINST F. & S. BY U. S. CIRCUIT COURT OF APPEALS REVERSING A LOWER COURT.

PHILADELPHIA, PA.
OCTOBER 7, 1914

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(*Concluded*)

0290. Would like to connect with research or experimental department of an automobile or accessory builder. Am now holding a responsible position with a well-known company and desire to change only on account of preferring the above-named work. Several years of valuable experience. Exceptionally good on electrical equipment. Quick and accurate in technical work. Married. Age 30.

0291. Managing and designing engineer in high-class construction desires position with large and progressive concern; 35 years of age.

0292. Engineer, 32 years old, desires responsible position with automobile, motor or accessory manufacturer. Twelve years' thorough practical training with large companies.

0293. Sales engineer with broad technical training and practical experience in sales, engineering and production, now handling ignition, lighting and starting equipment for automobiles in Detroit territory, desires opportunity of larger scope in this or other accessory line.

0294. Graduate mechanical engineer. Experience in motor and chassis design, experimental work and general production. Has initiative and resourcefulness. Would make capable assistant to chief engineer, production manager, etc. Location in eastern states preferred.

Smith Pressed Steel Frames

Are made by the Pioneer Manufacturers and represent the highest development of this industry—not alone in the quality of materials and workmanship, but in the equipment and methods of the largest and most complete frame plant in the world.

We also specialize in quantity production of REAR AXLE HOUSING ASSEMBLIES, DROP FORGINGS, and SPECIAL STEEL STAMPINGS.

A. O. Smith Company
MILWAUKEE

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DETROIT GEAR & MACHINE CO.

Detroit, Michigan

TRANSMISSION MANUFACTURERS

Unit Power Plant Transmissions to fit all standard motors up to 40 h. p.

"NORMA"

BALL BEARINGS

Builders of machinery requiring anti-friction bearings will find, in "NORMA" Bearings, those features of design and construction which are needed to maintain the reputation of a machine built to a quality standard. A machine is no better than its bearings. And a "NORMA"-equipped machine bears bearing insurance to protect its builder and its owner. ***Write for Bulletin 102.***

THE NORMA COMPANY OF AMERICA

1790 Broadway NEW YORK

"NORMA" ***Ball, Roller, Thrust and Combination Bearings***

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Members are requested to advise the S. A. E. office promptly of change of address, using form herewith:

SECRETARY,

SOCIETY OF AUTOMOBILE ENGINEERS,
1790 Broadway, New York City.

Please change my address now appearing on your records, to the following:

Company connected with.....

Profession or Position.....

Address of Company.....

Address for Mail.....

Articles Manufactured.....

.....

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.....

Very truly yours,

.....

S. A. E. Member.

Sometimes it takes months, sometimes even years for a motorist to come around to buying Kelly - Springfield Tires. That's because some people have more patience than others.

Kelly-Springfield Tire Company
Corner Broadway and 57th Street, New York

Branches and Distributors in All Principal Cities

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BIJUR
MOTOR LIGHTING COMPANY
HOBOKEN, N. J.

Standard Equipment LIGHTING STARTING **on**

Packard

AND MANY OTHER CARS.

COMPETENT ADVICE ON PROPER TYPE, SIZE AND APPLICATION OF ELECTRIC STARTERS.

COMPLETE DESIGNS FURNISHED.

SEPARATE OR COMBINED UNITS.

When planning Engine Driven Tire Pump Equipment, write for our blue prints and specifications. The

ENGINE DRIVEN
KELLOGG
TIRE PUMP

is the recognized standard. All metal, everlasting construction. Absolute guarantee against spraying oil.

Price which makes possible standard equipment on even the medium priced cars.

KELLOGG MFG. CO., Rochester, N. Y.

NEW YORK DETROIT BOSTON CHICAGO SAN FRANCISCO

A Great Machine Shop

Do you know that we employ nearly 1000 men in our machine shop alone, and that it is one of the best equipped in this country? It covers 85,000 square feet of floor space and contains 600 separate machines, all of up-to-date design.

For years we have specialized on the machining of gray iron castings and other motor car parts. We can save you money. Let us tell you what we can do for you.

THE FERRO MACHINE & FOUNDRY CO
CLEVELAND, OHIO

FERRO

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FILL OUT AND SEND TO S. A. E. OFFICE

SECRETARY,

SOCIETY OF AUTOMOBILE ENGINEERS,

1790 BROADWAY, NEW YORK CITY.

Please send application blank to

.....

NAME

.....

POSITION AND COMPANY

.....

ADDRESS

whom I consider eligible to S. A. E. membership.

.....

S. A. E. MEMBER

.....

ADDRESS

Date.....

HOOPES BRO. & DARLINGTON, INC.,
West Chester, Penna.
Manufacturers of
HIGH GRADE AUTOMOBILE WHEELS
in addition to their standard
WARNER, SARVEN AND SWEET BAND
CARRIAGE, WAGON AND TRUCK WHEELS
Prices on Application

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Westinghouse Electric Ignition

4-Cylinder

Westinghouse Electric Ignition includes automatic spark control, providing:

Accurate firing; maximum horsepower; maximum speed; minimum fuel consumption; minimum wear in engine due to correct firing; minimum attention to driving.

Westinghouse Electric Ignition combined with Lighting Generator, means:

Single unit; single drive; minimum weight; minimum installation cost; simplicity of power plant.

Westinghouse Electric Ignition includes Ignition Coil in Generator:

Self-contained; minimum wiring; minimum inductance; maximum life of contacts; accessible; clean dash.

6-Cylinder

Westinghouse Electric & Mfg. Co.

Automobile Equipment Division

East Pittsburgh, Pa.

MICHIGAN ELECTRIC WELDING COMPANY

DETROIT

BRAKE ROD AND DRAG LINK SPECIALISTS

Electric Welding solves construction problems. In our specially equipt plant we are prepared to turn out weldable automobile parts satisfactorily.

Perhaps we can assist in working out engineering problems; our experience is at your service. Mention the Bulletin.

MOTOR DU PONT FABRIKOID QUALITY

REG U S PAT OFF

IS GUARANTEED TO OUT-WEAR COATED SPLITS

It is replacing splits in the upholstery departments of several of America's largest auto manufacturers. Our top material is unsurpassed. Get a FREE SAMPLE and test it.

DU PONT FABRIKOID COMPANY

WILMINGTON, DEL. **TORONTO, ONT.**

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FILL OUT AND SEND TO S. A. E. OFFICE

SECRETARY,

SOCIETY OF AUTOMOBILE ENGINEERS,

1790 BROADWAY, NEW YORK CITY.

Please send application blank to

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NAME

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ADDRESS

whom I consider eligible to S.A.E. membership.

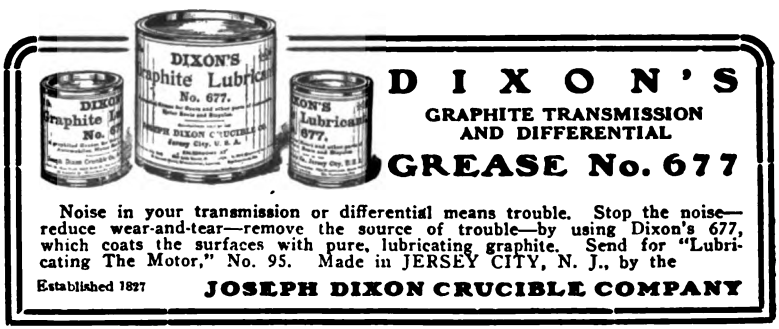
.....

S. A. E. MEMBER

.....

ADDRESS

Date .....


DIXON'S
No. 677.
DIXON'S
Lubricant
677.
DIXON'S
GRAPHITE TRANSMISSION
AND DIFFERENTIAL
GREASE No. 677
Noise in your transmission or differential means trouble. Stop the noise—reduce wear-and-tear—remove the source of trouble—by using Dixon's 677, which coats the surfaces with pure, lubricating graphite. Send for "Lubricating The Motor," No. 95. Made in JERSEY CITY, N. J., by the
Established 1827
JOSEPH DIXON CRUCIBLE COMPANY

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STEERING GEARS

We do not issue bulletin sheets for the S. A. E. note book, descriptive of our steering gears and differential gears, but would be very glad to send you blue prints and catalog descriptive of these.

It would pay you to write for this catalog and see what our new type fore and aft steering gears are, whether you use them or not. We have embodied features in the design and manufacture of this steering gear, which are unique and which make for much longer lived steering gears. Our method of supporting the steering arm to the rocker shaft is different from anything you have ever seen, and better than any other method ever used. Our means of lubricating the rocker shaft without grease cups or oil holes is also far superior to general practice. A full size blue print or a sample steering gear shipped for your inspection and to be returned at your pleasure, would give you some ideas as to the possibilities of strength and durability in steering gears that would surprise you.

Please write to us and let us know your requirements.

ROSS GEAR AND TOOL CO.

8th and Heath Streets Lafayette, Ind., U. S. A.

WE ARE EQUIPPED FOR QUANTITY PRODUCTION OF

GENUINE SQUARE TUBE HONEYCOMB MERCEDES TYPE, RADIATORS.

DUPLEX VERTICAL TUBE RADIATORS.

HELICAL TUBE TRUCK RADIATORS

GUARANTEED EFFICIENCY AND FIELD SERVICE.

We solicit correspondence, with blue prints of your requirements.

ROME-TURNEY RADIATOR COMPANY

ROME, NEW YORK

Automobile-Part STAMPINGS

STAMPINGS

G.P.&F. Service

KNOWING HOW SINCE 81

We are especially equipped to handle automobile-part work. Our facilities enable us to meet the most difficult situations in light and heavy sheet metal stamping or drawing.

Let us estimate on Hoods, Clutch Cases, Covers, Joint Cases, Housings, Pans, Shells, Drums, etc. Send Samples or blue print.

Geuder, Paeschke & Frey Co., 1365-1700 St. Paul Ave. Milwaukee, Wis.

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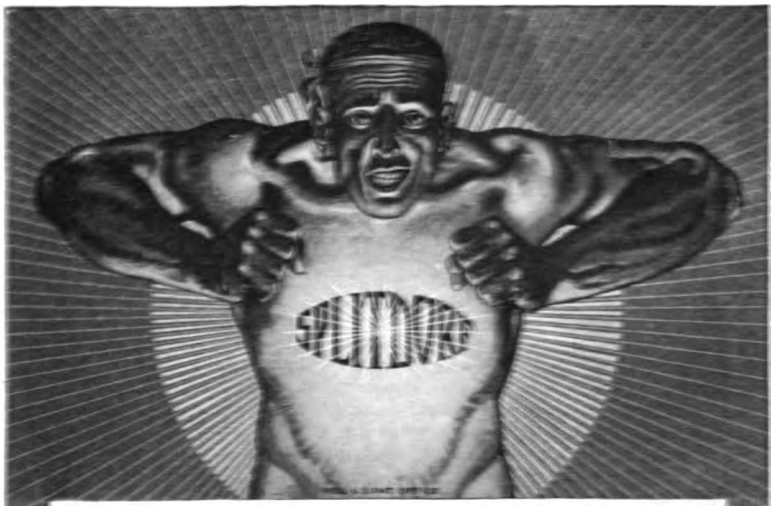
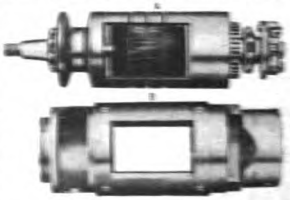


THE SPLITDORF ELECTRICAL COMPANY presents in their "Cunningham" Model "Six" a new type of water- and dirt-proof high-tension magneto whose range of spark advance extends over an arc of 70° and which is capable of producing flame sparks at the slowest engine speeds. It is constructed particularly for easy starting without the use of battery, auxiliary coils, or any external devices. The illustration gives an assembled view of the magneto (conforming to S. A. E. standards of measurement) showing water- and dust-proof construction.

In the lower figure *A* is a view of the armature showing the collector spool, bearings and circuit-breaker. *B* illustrates a sleeve construction mounted within the pole-pieces, rotatable with the advance lever. The armature *A* turns within the sleeve *B*. From this construction it will be seen that for any speed the break is always in the same position relative to the sleeve; that is, there is practically no difference in the strength of spark when the break is in advanced or retarded position, the speed remaining the same. By this construction an advance of 70° is obtained which is essential for long-stroke, slow-speed, six-cylinder engines.



Our Engineering Department is at Your Service

SPLITDORF ELECTRICAL COMPANY

NEWARK, NEW JERSEY, U. S. A.

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NEW DEPARTURE BALL BEARINGS

American Made for American Trade

In selecting a bearing equipment, four things should govern—Design, Quality, Delivery, Service. New Departure Cups and Cones, made from High Carbon Chrome Alloy Steel and filled with High Carbon Alloy Steel Balls, are accurate to .0001 of one inch in every essential measurement. Our factory floor space, now 13.52 acres, is growing. Our 2000 skilled workmen are now producing an average of 12,000 bearings daily. Deliveries are therefore immediate and sure. Our engineering department is at your command. Come here and satisfy yourself that New Departure Ball Bearings are right.

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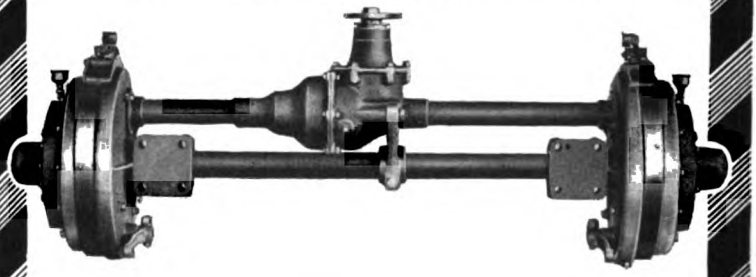
Russel

Internal Gear Drive Axle for One Ton Truck



FOR over a year our Engineering Department has concentrated its entire attention on the development of the one ton truck axle. Our investigations and tests have shown us the strength and weakness of the various rear drive systems now in use. The logical result has been the development of the one ton axle announced herein. We believe it represents the most serviceable compromise between the conflicting demands of durability, efficiency, quietness, simplicity, neatness and cost.

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North Detroit
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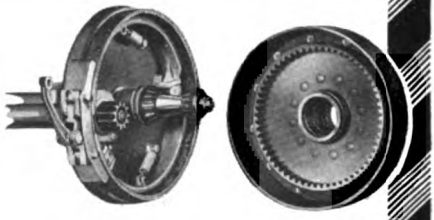

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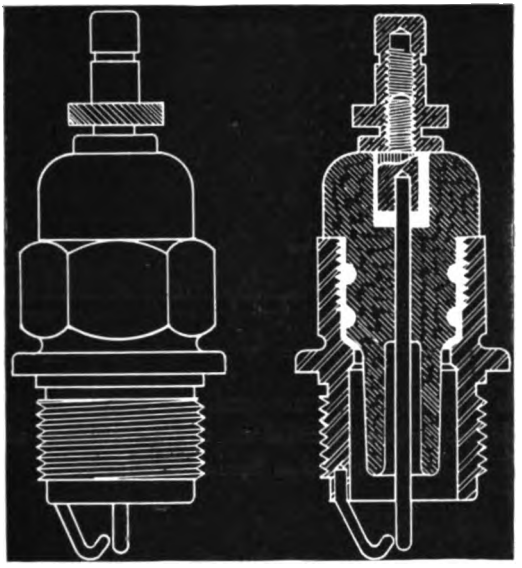

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Here is the new two-piece spark plug that has aroused the interest of leading engineers. It's the 1915 model

Red Head

and it embodies the only real improvements in spark plugs in the last ten years.

Prominent manufacturers have ordered quantities, based on the obvious merits of the construction alone.

On request, we will be pleased to submit plugs for testing purposes to manufacturers desirous of placing their spark plug equipment on an efficient footing.

Emil Grossman M'f'g Co. Inc.

Bush Terminal, Model Factory No. 20
Brooklyn, (New York City)
DETROIT, 708 Ford Bldg., E. T. Birdsall, M.E., Mgr.

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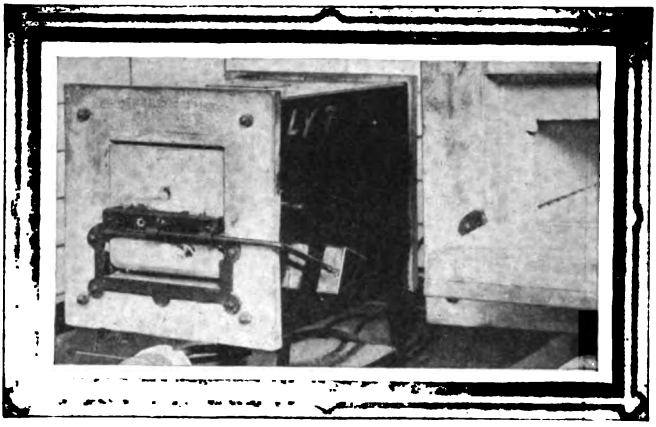

Electric furnaces for ascertaining recalescence and decalescence of steel in the Laboratory of The Perfection Spring Company

* * *

MISTAKES ONLY WASTE MONEY

OUR LABORATORY ELIMINATES MISTAKES

* * *

The Perfection Spring Company

Cleveland, Ohio

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VOL. VII NO. 2

S·A·E BULLETIN

NOVEMBER 1914

STANDARDS COMMITTEE DISCUSSION

ANNUAL MEETING PROGRAM

ELECTRIC VEHICLE SPEED AND MILEAGE RATINGS

DRAFTING ROOM SYSTEM

LARGE HEX SPARK PLUG

PNEUMATIC TIRE SIZES

FACTORS AFFECTING TIRE WEAR

TIRE FABRICS

SOCIETY OF AUTOMOBILE ENGINEERS
1790 BROADWAY, NEW YORK

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SAE BULLETIN

VOL. VII NOVEMBER, 1914 No. 2

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STANDARDS COMMITTEE CONVENTION

At the meeting of the Standards Committee held this month reports were submitted by twelve Divisions of the committee at its three afternoon sessions. As was expected, the reports consisted largely of statements of the manner in which the various subjects under consideration are being approached and the results of the sub-committee deliberations to date, the purpose being to disseminate widely among the members information as to the progress being made in the matter of recommending standards and practices, with a view to securing helpful discussion and suggestions. As will be noted in the abridged account given below, some specific recommendations were made by the Divisions and approved by the Standards Committee, the same being now before the Council for approval prior to submission for acceptance by the Society at its meeting to be held in January. The reports made by the Divisions this month are the result of the sub-committee work of the past several months, nearly all of the Divisions having held meetings this month.

The complete minutes of the Standards Committee meeting will be printed as soon as practicable after the various speakers

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have had adequate opportunity to approve or correct the stenographer's notes. Another meeting of the Standards Committee will be held on January fifth, at which time old and new business will be considered.

FELLOE BAND THICKNESS

The Commercial Car Wheels Division recommended that the thickness of the permanent metal felloe band for motor truck wheels be increased from ¼" to ⅜" for 4" single solid tires. This recommendation was made in view of the communications received from commercial car manufacturers and users and wheel builders. In the standard of the Society accepted some years ago the thickness of the felloe band was ¼" for equipment up to 4½" single tires and ⅜" for equipment with 4½" and larger single tires. It appears that the ¼" felloe band is not thick enough to give the draft that is necessary in wheel construction for 4" single tires.

The matter was given consideration with due reference to the proper desire not to change too quickly any previously accepted practice. The change will cause a slight increase in the weight and cost of 4" single tire equipment, but this seems worth while. The recommendation, if accepted by the Society, will not make any change in the present wheel diameter over the permanent metal felloe band.

The recommendation of the Commercial Car Wheels Division was accepted by the Standards Committee.

The Division also recommended for acceptance at a later meeting an increase in felloe band thickness from ⅜" to ½" for 6" dual tires and over. In the present standard the thickness of the felloe band is ⅜" for all sizes of dual tires.

It is the wish of the Division that prior to final consideration of this recommendation an opportunity shall be afforded the truck manufacturers and others interested to submit their views. It seems that the thicker felloe band is necessary to preserve the structure of the wheel under severe duty on a heavy truck. In the case of wheels in which spokes are off-center, which is common practice, there is evidence in the hands of the wheel makers that the wheel will not stand up under the strain with a ⅜" thick felloe band. Increasing the felloe band thickness to ½" as stated, would increase the weight and price seriously.

The Division had in hand no data to indicate that offset wheels equipped with ½" thick felloe bands would stand up any better than those equipped with ⅜" thick felloe bands. The wheel makers who have expressed views on the subject state, however, that ½" thick felloe bands would improve matters materially and

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obviate to a large extent the present difficulties. In the present standard there is only 1/8" of material between the outer edge of the bolt holes in the bolt-hole circles and the inside of the felloe band. Inasmuch as changing the dimensions of the bolt-hole circle would be a serious matter, the possible increase in felloe band thickness is limited by the present standard in that respect. The members of the Standards Committee appeared to have grave doubts whether the proposed change would be of enough benefit to warrant making it. It was stated by some that the whole trouble with the wheels of the size in question is due to offset spokes and improper wheel construction or the use of inadequate machinery, as well as improperly cured material for the building of very heavy wheels. It is difficult to design centrally located spokes for wheels to be used with chain drive.

A lengthy discussion of wheel construction was had with reference to the loosening of spokes in the felloes; the area of the shoulder on the spoke at the felloe end; support from the hub to the outer edge of over-hung felloes; length of tenon, etc.

The Commercial Car Wheels Division further announced that it will take into consideration recommending that the side flanges or clamps for tire attachment to wheels be so designed as to have a flat surface for contact with the sides of wood felloes, to give sufficient bearing surface to avoid crushing the wood felloe.

WIRING SYSTEMS

The Electrical Equipment Division announced that, understanding that the Society does not care to have recommended for practice a system of wiring electrical installations on gasoline cars, a resolution had been passed by the Division to the effect that consideration of the subject by it shall be deferred until further development shall make it necessary to take the subject up again. In answer to an inquiry sent out recently by the Society as to practice among car manufacturers on 1915 gasoline car models, 38 replies were received; 27 of the car manufacturers favoring the one-wire system and 11 the two-wire system. It was estimated that approximately 220,000 cars will be built this season equipped with the one-wire system and approximately 98,000 with the two-wire.

NON-GLARING HEADLIGHTS

It was announced that a sub-committee on non-glaring headlights had been appointed, it being understood that after collecting copies of the ordinances of the various cities on the subject, a specification of what constitutes a glaring light would be drafted, with a view to determining results to be accomplished by

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whatever device or devices may be recommended. At the present time there is no fair measure of what a glaring headlight is. There are three types of devices to be considered in the possible solution of the problem in question, namely, those deflecting, dimming or shading the glaring rays in some manner.

The subject is divided naturally into two parts, lights for city driving and lights for country driving. The principal difficulty in this connection is the extent to which lights required for country driving are also required in poorly lighted portions of the cities, or at least some light stronger than that countenanced by various city ordinances. A very large part of the average motorist's driving is under conditions where a bright searchlight is not necessary and a uniform and well-diffused illumination of the road immediately in front of the car suffices. Such a light, it was stated, could be designed without producing an undue amount of glare, by diffusing the light to the sides of the road and directing it downward on the ground. To accomplish this it is possible that it would be necessary to abandon the present forms of reflector. With the requirement stated satisfied, the light equipment can perhaps properly be supplemented by a searchlight without dazzling beams for country driving. It is alleged that at the present time lighting systems are being designed for extraordinary or abnormal rather than normal use.

It is thought that it would be very beneficial for the Society to formulate the limitations of a non-dazzling lamp, as the lamp designers would then have something on which to base their calculations and the law makers informing data, resulting in giving the automobile owner as much leeway as possible, and still protecting other users of the highways.

To the broad fact that statutes do not exist or are not enforced in various states requiring all vehicles to carry lights, is largely due the existence of the objectionable headlight.

It was pointed out in the meeting that single centrally located lights on the front or rear vehicles do not indicate sufficiently the exact position of the same in the road; that is, that in the case of such equipment the single light should be placed on the left side of the vehicle for proper safety.

FITTINGS FOR SINGLE-WIRE SYSTEMS

It is expected that the sub-committee on Single-Wire System Fittings will have a report ready for submission at the next meeting of the Society. The recommendation received by the Division to supplement S. A. E. Data Sheet 48d, Vol. I, specifying temperature at which fuses shall carry their rated capacity and the over-load at which they shall blow, as well as temperature test without electrical load, was referred to this sub-committee.

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LAMP NOMENCLATURE

The recommendation of the Electrical Equipment Division that the detachable electrical light-giving unit comprised of a filament and its glass envelope should be designated by the word "bulb," and the fixture for mounting and utilizing the light of the bulb designated by the word "lamp," was approved.

BULB BASE, SOCKETS AND CONNECTOR PLUGS

It was announced that a sub-committee of the Division had been appointed to investigate a standard of dimensions and tolerances for single-contact Ediswan bulb base and double-contact Ediswan bulb base, lamp sockets and connector plugs to be used with the same.

LAMP BRACKET DIMENSIONS

The matter of dimensions of brackets for head-, side- and tail-lamps will be considered by a sub-committee. Several years ago the National Association of Automobile Manufacturers adopted a standard in this connection. This standard has, however, been dormant; but in view of the fact that there is not a great deal of variation in the dimensions in current practice, it appears that standard dimensions may be adopted. A proper investigation of the subject will be made in order to avoid any undue hardship being inflicted by the adoption of specific dimensions.

JUNCTION BOXES

The Electrical Equipment Division reported that it favors considering at an early date the matter of recommending the provision in all wiring systems of a junction box, together with at least one open connection, to be used whenever electrical appliances are to be added to cars after the same leave the car manufacturers' plants.

FRAME SECTIONS

The Third Report of the Frame Sections Division, which has been scheduled for discussion at past meetings of the Society, but not discussed for lack of time, was taken up for consideration, some more recent data being submitted. It was understood that the report would be revised in several respects in view of the lengthy discussion had and be submitted in amended form at the Standards Committee meeting to be held on January fifth.

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STANDARD LOCK WASHERS

The Lock Washer Division reported that after discussion of the matters which had come before it, it had reached the conclusion that there is no apparent necessity for adding to or changing the S. A. E. standard of lock washers, so far as dimensions are concerned, but that it appears advisable to specify more clearly the properties of the material from which lock washers should be made. The Division expects to submit a concrete recommendation in the last-mentioned respect at the next meeting of the Standards Committee.

SIDE-OUTLET CARBURETERS

A statement was made of the manner in which the Carbureter Fittings Division is proceeding in considering recommending standard fittings for side-outlet carbureters. Repeated advices have been received at the office of the Society that it would be desirable to standardize the manner of locating the flanges on side-outlet carbureters which are coming into use more and more with the block type of motor. It has become evident that the motor builders want something definite as to the method of bolting. Some of them suggested, however, that the matter be left to the carbureter builders, since it makes no difference to the motor builders whether the bolts in the attaching flange are in a horizontal or vertical line. It has appeared that the carbureter makers prefer the vertical center line for bolts. It was pointed out in the Standards Committee meeting that with this design of flange the lower bolt is difficult to put in place and get at. The whole question under consideration is whether the bolts shall be mounted with centers in a horizontal or vertical line, the S. A. E. standard flange dimensions being applicable in this case as in others. One carbureter manufacturer argued that the vertical flange with horizontal throttle-shaft is preferable, as at idle running the lowest passage beneath the disc is always swept clean of fuel, a small notch in the lower edge of the disc giving more steady idling and the horizontal shaft preventing deflection of the gas to either the front or rear cylinders. This latter trouble often occurs even when a manifold is used and can be overcome by increasing the length of the vertical portion, which change the horizontal type prevents. The carbureter people seem to think that the throttle shaft should necessarily be perpendicular to the bolting.

The report made by the Carbureter Fittings Division was one of progress only, it being understood that samples showing the points under discussion would be submitted at the January meeting.

It was suggested that 5/8" and 3/4" sizes be added to the

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S. A. E. standard flared tube union list for carbureter fittings, the same proportions being followed as in the present list.

The S. A. E. standard specifies a tolerance of .002" in the diameter of the hole in the union nut. Since this is a screw-machine job, it is held that a variation of .002" is not enough, and it is proposed to increase the tolerance to .005". It was understood that the Carbureter Fittings Division would take this matter under advisement.

AIR PUMP DIMENSIONS

It was reported by the Miscellaneous Division that the dimensions of mechanically driven air pump for motor cars, accepted at the January, 1914, meeting of the Society, have not been put into practice by manufacturers, and that in the opinion of the Division the subject of the standard should be re-opened. It has been demonstrated that the trend of development in the installation of the pumps has not been that contemplated in the determination of the accepted dimensions. Some car makers are now mounting the pump on the base formerly used for mounting the magneto. It appears that all of the eleven dimensions accepted as standard are used by no one manufacturer, five are used by one or more, and five are not used at all. Most of the pumps now being installed are of the one- or two-cylinder type instead of the four-cylinder.

It was the sense of the Standards Committee that the Miscellaneous Division should reconsider the whole subject.

ROD AND YOKE END PINS

The Miscellaneous Division submitted specifications for pins for S. A. E. standard yoke and rod ends, including pin dimensions, cotter pin diameter and length and drill size number and diameter. A number of changes in the specifications were, however, suggested at the Standards Committee meeting, and the report on the subject was referred back to the committee with the request that the same be revised and resubmitted.

LARGE HEX SPARK PLUG SHELL

Drawings were submitted of a large hex spark plug shell, together with the present S. A. E. standard 7/8-18 spark plug shell slightly modified. This is a subject which has been discussed repeatedly at Society meetings. It is not the intention that the large hex shell shall supersede the present S. A. E. standard (formerly A. L. A. M.) but supplement the same, there having been a demand for a construction taking a larger porcelain.

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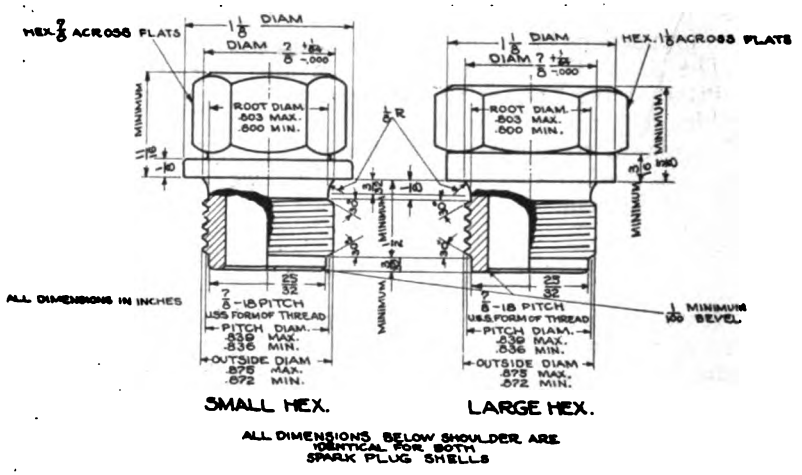
HEX. 7/8 ACROSS FLATS
1 1/8 DIAM
DIAM 7/8 +.000 -.005
ROOT DIAM. .803 MAX. .800 MIN.
MINIMUM
R
ALL DIMENSIONS IN INCHES
7/8-18 PITCH U.S.S. FORM OF THREAD
PITCH DIAM. .839 MAX. .836 MIN.
OUTSIDE DIAM .875 MAX. .872 MIN.
1/100 MINIMUM BEVEL
SMALL HEX.
HEX. 1 1/8 ACROSS FLATS
LARGE HEX.
ALL DIMENSIONS BELOW SHOULDER ARE IDENTICAL FOR BOTH SPARK PLUG SHELLS

In addition to the spark plug shell matter, which is illustrated herewith, the Miscellaneous Division submitted thread data in relation to the spark plug shell. If the spark plug taps are made to the dimensions shown in the accompanying table, the spark

THREAD DATA
7/8—18 U. S. S. FORM OF THREAD

	Nominal Dimension	THREAD LIMITS	
		Spark Plug	Tap
Outside diameter.....	.875	.872 Min. .875 Max.	.877 Min. .879 Max.
Pitch diameter.....	.839	.836 Min. .839 Max.	.841 Min. .843 Max.
Root diameter.....	.803	.800 Min. .803 Max.	.805 Min. .807 Max.

Tap Drill Diameter
Nominal 13/16 = .8125
.810 Min. .813 Max.

All dimensions in inches.

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plugs can be screwed in by hand, using a wrench for final tightening only. The clearances also make it easier to pull the spark plug down to a proper seat on the gasket. The tap drill diameter recommended makes it possible to buy a 13/16" tap drill and use it until it wears down to .810".

The recommendations of the Miscellaneous Division as to spark plug shells and thread data for the same were approved by the Standards Committee.

EXTENSION OF THREAD STANDARD BEYOND 1½" DIAMETER

In the matter of the extension of the screw thread standard beyond 1½" diameter, the Miscellaneous Division recommended pitches of fine and coarse threads. It was not the intention to go into the matter of units or bolts but merely specify pitch of thread, the same being of the United States Standard form as in the case of the S. A. E. screw standard.

The coarse threads to be as follows:

Beginning at 1⅝" and advancing by ⅛" increments and extending to 2⅞" inclusive, 12 threads per inch.

Beginning with 3" and advancing by ⅛" increments to 5⅞" inclusive, 10 threads per inch.

Beginning with 6" and advancing by ⅛" increments up, 8 threads per inch.

The fine threads to be as follows:

Beginning with 1⅝" and advancing by ⅛" increments to 2⅞" inclusive, 18 threads per inch.

Beginning with 3" and advancing by ⅛" increments up, 16 threads per inch.

These recommendations were presented after a careful survey of data submitted by 22 motor car manufacturers, together with returns received from parts manufacturers and tap manufacturers.

Present practice reveals no harmony in the use of large screw threads. The sizes recommended are representative of the practice so far as indicated and discussion on the same was invited. For reasons of memorizing, a very simple standard is wanted. It is thought that two series of pitch are necessary, one for use in cast metal and the other in steel.

It is interesting to note that in the fine thread between 1⅝" and 2⅞" inclusive, which practically covers the sizes for valve port plugs, a 2½" outside diameter valve will just drop through a 2⅝"-18 tapped hole; this is a practice used by a good many manufacturers, avoiding going into 16ths or decimal fractions.

The report on screw threads was submitted as one of progress only.

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COTTER PIN STANDARDIZATION

It was stated in the meeting that it is feasible to standardize on approximately twenty cotter pin sizes, as against the two hundred or more sizes in use at present. It was also pointed out that no standard method of measuring the length of cotter pins is in general use.

The diameters of cotter pin for use in connection with S. A. E. standard castle nuts are specified, and as above stated, it is contemplated that the length as well as diameter of cotter pins for use in S. A. E. standard rod and yoke end pins will be specified. It has been found by some that considerable saving can be made in stocking by standardizing cotter pin sizes, a great many of the currently used diameters and lengths being entirely unnecessary and inevitably accumulating in absurd numbers. It does not make any practical difference in a majority of cases whether a 1¼-inch or a 1⅛-inch long cotter pin is used.

PHYSICAL PROPERTIES OF S. A. E. STEELS

During the past year the Iron and Steel Division has been giving special attention to the problem of presenting a set of data sheets which would show the physical properties which may be expected from each S. A. E. steel when given the most widely used heat treatment applied to the respective steel. Tentative tabulations and curves for carbon steels 1020, 1025, 1035 and 1045 have been prepared and submitted to the Iron and Steel Division for criticism, looking toward the formulation of principles which will allow of the extension of the work to cover alloy steels as well. The tabulations and curves, when completed and thoroughly threshed out, will be published. It is expected that the data for the carbon steels at least will be issued at the time of the next meeting of the Society.

STEEL CASTINGS SPECIFICATIONS

In the matter of steel castings specifications supplementary to the present S. A. E. 1235 specification which has been under reconsideration by the Iron and Steel Division, advices from the American Society for Testing Materials are being awaited, it being expected that the specifications of that society will be recommended by the Iron and Steel Division if they shall prove applicable to motor car practice. It is thought that at least two qualities of steel castings should be specified.

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STANDARD SIZES OF PNEUMATIC TIRES

The sizes of pneumatic tires that are under consideration for recommendation as practice for the car manufacturers are all, as it is stated they should be, even sizes, permitting the car user to oversize if he wishes. The sizes are 30x3, 30x3½, 32x3½, 32x4, 34x4, 34x4½, 36x4½, 38x5½ and probably 36x5. Oversize tires for all these sizes will probably be manufactured by the tire companies, 31x3½ for the 30x3, 31x4 for the 30x3½ and so on down the list.

If the car manufacturer equips his product with an oversize tire, he leaves his customer no chance for oversizing in case the latter increases the total weight of the car by adding extra equipment, etc.

It is stated that there has never been a question in the minds of the Clincher Automobile Tire Manufacturers' Association committee but that there should be a 5″ tire. The question has been whether it shall be a 36″ or 37″ tire.

It is understood that 85 per cent. of the tires used today are included in the above given list of even tire sizes.

INFLATION PRESSURE AND CARRYING CAPACITY

The question of standardizing inflation pressures and carrying capacities of pneumatic tires was scheduled for discussion but specific recommendation was deferred in view of the fact that it seems that the tire manufacturers through their association will soon have a standard to propose in this respect. The lists of inflation pressures and carrying capacities which have hitherto been published by the tire companies have varied somewhat and not been lived up to generally. It is appreciated that new lists should be prepared, taking more into consideration the actual usage among car owners, with the hope of having the new figures lived up to. The average actual practice today is hard on tires. The relation between the requisite inflation pressure and the respective load carried by tires has been ignored too much. In other words, the proper inflation pressure varies with the weight carried. Many car users equip with oversize tires for the sake of easier riding. Easier riding is not secured by carrying the same arbitrary inflation pressure per inch of tire cross-section regardless of load; it stands to reason that the inflation pressure may be less if the load remain the same and the tire be increased in size.

Tire manufacturers agree that there is a certain allowable percentage of deflection; some say 9 per cent., some as high

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as 15 per cent. The deflection is directly proportional to the pressure per square inch. It has been stated that on the average the tiring of cars is on the basis of .5 to .6 pound weight per cubic inch of tire volume.

The under-inflation condition has been recognized for a long time and is very unsatisfactory. Another bad condition which it is alleged exists is overloading. It is averred that over 90 per cent. of the cars manufactured today leave the factories with a greater load on the tires than the average prescribed in the tables of the tire companies.

RIM STANDARDIZATION

It is the view of the Pleasure Car Wheels Division that it is impracticable at this time to make any specific recommendation as to the standardization of demountable rims for pneumatic tires. Within a year the general tendency may develop a situation wherein such recommendation can properly be made.

ROLLER BEARING SIZES

The discussion had at the last meeting of the Standards Committee on the demand for and feasibility of reducing very materially the stock list of bearings of the taper roller class, was resumed. The question is whether the unstandardized series of three hundred odd sizes shall be left alone to continue and multiply, or be reduced to manufacturable proportions of approximately fifty sizes covering all normal demand. Two makers of bearings favor the reduction of the number of sizes. One states that the standardization in mind would be disadvantageous to the bearing manufacturer and to the car manufacturer.

The Ball and Roller Bearing Division is working towards the reduction of the number of sizes to a reasonable workable limit. It hopes to formulate a list of standard sizes of roller bearings which will be not only a credit to the Society but of great help to the automobile designer.

The annular ball bearing came here from abroad pretty well standardized as to general dimensions, although not as to tolerances. No one thinks of adopting any ball bearing not found in some of the ball bearing manufacturers' catalogues, which are fortunately all alike, the first one having been copied as being a good thing. If a similar condition can be brought about in the case of taper bearings, thrust washer bearings and plain roller bearings, corresponding benefit will result. There are no lists extant now by which this can be accomplished. A car designer makes a spindle and after everything is ordered finds there is no bearing just right for the spindle. The bearing maker

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has to make a special bearing to suit. The solution of the problem lies in the publishing and distribution of a suitable list for reference use, exactly as in the case of the annular ball bearing list.

THRUST BEARING SIZES

It was announced that a committee of manufacturers of thrust bearings had been chosen to revise the list of sizes and types in this class.

TAP DRILL SIZES

The Research Division reported that considerable experimenting had been done by various members of the Division to determine proper tap drill sizes, and expressed the view, based on this work, that for the utmost value to the industry much more experimenting in detail should be carried out. So far the experiments have been made with cold rolled bolt stock of about 80,000 pounds per square inch yield point, and nut material of cast brass, cast aluminum and cast iron.

To fortify the Division in its investigation and to standardize the conditions of test, arrangements will be made to furnish the necessary specimens for test. All question of variation in material or workmanship will thereby be obviated. Bolts for test will be made of cold rolled screw stock (S. A. E. Steel 1114), heat treated nickel chromium steel (S. A. E. Steel 3135 or 3125), heat treated nickel steel (case-hardened cap screws), S. A. E. Steel 1020, cyanided.

It is purposed that the method of testing in general shall be of two kinds; static, of the regulation tension kind; rotating, while rotation of the nut or bolt is accomplished. The latter method of test is desirable for the reason that the results will represent much more closely the conditions met with in actual practice. The time when either a bolt or nut is broken is usually when it is being screwed up.

It is suggested that there be made in addition an investigation involving various depths of hole in such materials as aluminum, brass and cast iron, for the purpose of determining strength of thread against shearing in materials of less strength than that of the bolt.

VEHICLE TAXATION FORMULA

The Research Division made a progress report on another matter it has under advisement, namely, the determination of a vehicle taxation formula as discussed at the last meeting of the Society. A careful preliminary study has been made with the

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result that the Division believes the following factors may be involved in such a formula:

1—Horsepower;
2—Total weight of loaded car;
3—Gear ratio;
4—Speed;
5—Type of wheel.

In determining the proper weight to give these and other possible factors, the Division proposes to avail itself of government work by the Bureau of Good Roads, as well as of published results of other societies.

Three types of vehicle are being considered:

1—Pneumatic-tired vehicles;
2—Solid-rubber-tired vehicles;
3—Horse-drawn vehicles.

In this connection it may develop that several factors will be given three different values for the three classes respectively or that three distinct formulas shall be deduced.

ELECTRIC VEHICLE DIVISION REPORT

The Electric Vehicle Division sub-committees on Motors and Controllers, on Batteries, Wiring and Charging Appliances, on Lamps, on Steel and Mileage Ratings, and on Tires have been prosecuting actively their work, which has consisted in a large measure of the collection of statistics and statements of established practice.

The sub-committee on Motors and Controllers has made a preliminary report discussing particularly the standardization of two motor voltages, which it is contemplated will be recommended for adoption at a later date, namely, 60 to 66 volts and 80 to 85 volts.

The standardization of name plates was also discussed and recommendations will be made later. Discussion was also had on the testing, ampere-rating, insulation, etc., of controllers.

A committee of the Underwriters' Laboratories has been appointed to investigate fire risks in connection with electric vehicles and gasoline vehicles having electric equipment. It was stated that the said organization is not informed as to good current practice or as to the elements of fire risks existing in the stated classes of vehicle. The co-operation of the S. A. E. through the Electric Vehicle Division in accumulating data by which the underwriters would be enabled to formulate a code,

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has been requested. A list of questions covering current practice on features considered essential will be submitted to the Division.

The sub-committee on Batteries, Wiring and Charging Appliances will make later recommendation on a wide range of subjects, including the grouping of cells in battery trays, the number of cells in standard battery equipments, with the intention of recommending 42 cells lead and 60 cells Edison, wiring sizes, insulation, charging receptacles, fuses, polarity of battery terminals and other allied matters.

The sub-committee on Lamps will submit later recommendations regarding lamp bases, voltage and other matters, depending to some extent upon the adoption of standard battery voltages.

ELECTRIC VEHICLE SPEED AND MILEAGE RATINGS

The sub-committee on Speed and Mileage Ratings made a report which, after very extensive discussion, was adopted by the Division for submission to the Standards Committee for acceptance, as follows:

Electric Vehicle Speed Ratings shall be based on continuous operation with half load over hard, smooth and level roads or pavements at the actual average battery voltage.

Electric Vehicle Mileage Ratings shall be based on the rated five-hour discharge capacity of the battery and a continuous run with half load over hard, smooth and level roads or pavements.

These recommendations were approved by the Standards Committee.

EFFICIENCY TEST OF SOLID RUBBER TIRES

The sub-committee on Tires report on extensive efficiency tests made of solid rubber tires. The tests were made with the scleroscope and the Whitney tire tester and also checked by road performance. The sub-committee is investigating the subject of hardness and other qualities in solid rubber tires and will report on the subject further at a later date.

INDUSTRIAL TRUCKS

A number of new matters were brought to the attention of the Electric Vehicle Division and referred to the respective sub-committees having jurisdiction, among these matters being the standardization of electrical features of industrial trucks, which will be reported upon subsequently.

STANDARD EXCHANGE DIVISION REPORT

It is the function of the Standards Exchange Division to keep abreast of the standards and engineering practices adopted by the Society and by written communication and conferences arrange that the established standards of other organizations

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harmonize with the S. A. E. Standards so far as practicable. At the present time the Standards Exchange Division is working assiduously with the Automobile Engine Manufacturers Association in endeavoring to make the standards of the two associations coincident as far as possible. The American Society for Testing Materials has a committee on automobile steels. Assurance is given that this organization will accept practically *in toto* the specifications adopted by the S. A. E. The A. S. T. M. also has a committee on spring steels with which the S. A. E. committee is working in close harmony.

BELL HOUSING DIMENSIONS

A vital question before the automobile engine builders is the matter of standardizing bell housing dimensions, the dimensions of the rear end of the motor forming the junction between the engine and gear-box. The S. A. E. committee obtained from a prominent manufacturer of transmissions a tentative list of dimensions which had been set up as informal standards by the motor manufacturers. This list was made up in blue-print form and sent to all the manufacturers interested, about fifteen in number. They were asked to submit blue-prints or fill in dimensions on the blue-prints sent them, in order to find out to what extent current practice coincides. Five different sizes have been listed, ranging from the largest that might be used on a truck, where a large flywheel is an important factor, down to the small size bell housing which is used on the light-car type of four-cylinder motor. A tabulation of the returns received revealed practically a unanimity of practice in all the sizes except the largest, which is manufactured to a very slight extent, and in the smallest. The work of the committee will be focused during the next few months on the small size in an effort to obtain some unanimity of opinion as to what the standard dimensions should be. The present variation in dimensions is small, but of course any variation at all in this case is a great impediment to interchangeability and the desirable features of standardization.

MOTOR SUPPORT DIMENSIONS

The Standards Exchange Division has also had in view the possibility of standardizing the reach of motor support arms at the rear end of the motor and the drop between the fundamental base point of the arms and the center of the crankshaft; the idea being to make the arms as narrow as possible so that motors will be interchangeable by simply putting in different sized brackets to fasten the motor to the frame. There is considerable variation in the practice as to the dimensions in question. The work of the Division will consist in part in drawing up a tentative set of dimensions and submitting the same to car designers and engine builders for approval.

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REGISTRATION AT STANDARDS COMMITTEE CONVENTION

Apple, V. G. (Electrical Equipment Division), President and General Manager Apple Electric Company.

Armstrong, J. R. C. (Electric Vehicle Division), Chief Electrical Engineer, General Vehicle Company.

Aull, Jerome J. (Carbureter Fittings Division), Mechanical Engineer, The Lunkenheimer Company.

Bachman, B. B. (Truck Standards Division), Assistant Engineer, Autocar Company.

Baldwin, H. S. (Electric Vehicle Division), Engineer, General Electric Company.

Barton, H. L. (Pleasure Car Wheels Division), Assistant Director of Production, General Motors Company.

Bijur, Joseph (Electrical Equipment Division), President, Bijur Motor Lighting Company.

Bryant, R. S. (Pleasure Car Wheels Division), Consulting Engineer, Standard Welding Company.

Buckwalter, T. V. (Industrial Truck Standards Advisory Committee), Engineer, Pennsylvania Railroad.

Bunnell, C. M. (Electrical Equipment Division), Miniature Lamp Sales, General Electric Company.

Buswell, W. H., Archibald Wheel Company, Lawrence, Mass.

Carlton, C. C. (Pleasure Car Wheels Division), Firestone Tire & Rubber Company.

Carpenter, R. C. (Research Division), Professor of Experimental Engineering, Sibley College, Cornell University.

Church, H. D. (Commercial Car Wheels Division, Truck Standards Division), Truck Engineer, Packard Motor Car Company.

Churchward, Alex. (Electrical Equipment Division), Vice-President, Gray & Davis, Inc.

Clarkson, Coker F., Secretary and General Manager, Society of Automobile Engineers.

Clemens, C. E. (Springs Division, Truck Standards Division), Mechanical Engineer, Perfection Spring Company.

Coleman, H. B., Hoopes, Brother and Darlington, Inc.

Conant, W. H. (Electrical Equipment Division, Electric Vehicle Division), Detroit Manager, Gould Storage Battery Company.

Clement, Carl H., Bock Bearing Company.

Davis, C. E. (Lock Washer Division), Consulting Engineer, New York City.

Ehle, A. H. (Truck Standards Division), Manager Electric, Compressed Air and Gasoline Locomotive Department, Baldwin Locomotive Works Division.

Fishleigh, W. T. (Research Division), Assistant Professor, Engineering Department, University of Michigan.

French, E. L. (Iron and Steel Division), Manager Sanderson Brothers Works, Crucible Steel Company.

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Fried, E. R. (Standards Exchange Division), Ferro Machine and Foundry Company.

Gallup, David L. (Research Division), Professor of Gas Engineering, Worcester Polytechnic Institute.

Germane, F. M. (Ball and Roller Bearings Division), Assistant General Manager, Standard Roller Bearing Company.

Gould, W. S., Gould Storage Battery Company.

Gray, B. D. (Ball and Roller Bearings Division), Vice-President and Manager Hess-Bright Manufacturing Company.

Hall, E. R. (Pleasure Car Wheels Division), Experimental Engineer, Goodyear Tire and Rubber Company.

Harper, H. W. (Electrical Equipment Division), President, Howard Miniature Lamp Company.

Heldt, P. M., Editor, *The Horseless Age*.

Holland, W. E. (Electric Vehicle Division), Research Engineer, Anderson Electric Car Company.

Holmes, Arthur (Iron and Steel Division), Vice-president, H. H. Franklin Manufacturing Company.

Hoopes, Russell (Commercial Car Wheels Division), Superintendent, Hoopes, Brother and Darlington, Inc.

Hughes, F. G. (Ball and Roller Bearings Division), Chief Engineer, New Departure Manufacturing Company.

Kebler, Leonard (Electrical Equipment Division), President, Ward Leonard Electric Company.

Kennedy, W. P. (Commercial Car Wheels Division, Truck Standards Division, Electric Vehicle Division), Consulting Engineer, New York City.

Lee, T. L., North East Electric Company.

Libby, A. D. T., Splitdorf Electrical Company.

Lloyd, Robert McA. (Truck Standards Division), Consulting Engineer, New York City.

McComb, H. G. (Industrial Truck Standards), Engineer Gasoline Division, General Vehicle Co., Inc.

McKinley, C. W. (Lock Washer Division, Springs Division), Chief Engineer, Willys-Overland Company.

McMurtry, Alden L. (Electrical Equipment Division), Consulting Engineer, Sound Beach, Conn.

Mathews, J. A. (Iron and Steel Division), General Manager, Halcomb Steel Company.

Morgan, R. L. (Springs Division), Consulting Engineer, Worcester, Mass.

Moyer, J. A. (Research Division), Professor in charge of Department of Mechanical Engineering, Pennsylvania State College.

Myers, C. T. (Truck Standards Division), Engineer, Timken-David Brown Company.

Newkirk, W. M. (Springs Division), Mechanical Engineer, William and Harvey Rowland, Inc.

Nightingale, R. J. (Electrical Equipment Division), Manager Auto Sales, Willard Storage Battery Company.

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Norton, W. T., Jr. (Standards Exchange Division), Chief Engineer, Selden Motor Vehicle Company.

Osburn, H. G. (Electrical Equipment Division), Mechanical and Electrical Engineer, National Metal Molding Company.

Parker, J. H. (Iron and Steel Division), Metallurgist, Carpenter Steel Company.

Perrin, J. G. (Frame Sections Division), Chief Engineer, Lozier Motor Company.

Pierce, Dana, Underwriters' Laboratories, Inc.

Pope, N. B. (Miscellaneous Division), Technical Editor, *Automobile Topics.*

Roberts, W. H. (Truck Standards Division), Assistant Engineer, Department of Finance, New York City.

Roesch, D. (Research Division), Assistant Professor of Experimental Engineering, Armour Institute of Technology.

Ross, E. J., Jr. (Electric Vehicle Division), Manager Sales Engineering Department, Edison Storage Battery Company.

Russell, E. F. (Iron and Steel Division), Longmeadow, Mass.

Rys, C. F. W. (Iron and Steel Division), Metallurgical Engineer, Carnegie Steel Company.

Schipper, J. E., Technical Editor, *The Automobile.*

Slade, A. J. (Electric Vehicle Division), Consulting Engineer, New York City.

Slauson, H. W., Manager Motor Department, *Leslie's Weekly,* New York City.

Souther, Henry (Iron and Steel Division, Pleasure Car Wheels Division), Vice-president and General Manager, Ferro Machine and Foundry Company.

Utz, J. G. (Miscellaneous Division), Consulting Engineer, Perfection Spring Company.

Veal, C. B. (Research Division), Professor of Machine Design, Purdue University.

Ward, C. A. (Electric Vehicle Division), Secretary and Treasurer, Ward Motor Vehicle Company.

Welch, C. J., U. S. Tire Company.

Wesley, G. W. (Electric Vehicle Division), Vice-president, General Vehicle Company.

Whitney, E. R. (Commercial Car Wheels Division, Truck Standards Division, Electric Vehicle Division), Chief Engineer, Commercial Truck Company of America.

Whitten, F. A. (Electric Vehicle Division), Chief Engineer, General Motors Truck Company.

Wilson, J. E. (Lock Washer Division), Mechanical Engineer, National Lock Washer Company.

Williams, C. B. (Pleasure Car Wheels Division), Treasurer, Mott Wheel Works.

Zimmerschied, K. W. (Iron and Steel Division, Standards Exchange Division), Chief Metallurgist, General Motors Company.

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TENTATIVE PROGRAM

ANNUAL MEETING

New York, Tuesday, Wednesday and Thursday, January 5, 6, 7, 1915

at the

SOCIETY HEADQUARTERS

1790 Broadway

and in the

AUDITORIUM OF THE ENGINEERING SOCIETIES BUILDING

29 West 39th Street

Information for Attending Members

THE REGISTRATION BUREAU will be open from 9 a. m. to 9 p. m. Wednesday and Thursday at the entrance to the auditorium, on the third floor of the Engineering Societies Building. To avoid confusion and to aid the Meetings Committee, all who attend are requested to register promptly. This applies to members and guests, including ladies. Upon registration, badges, programs and papers will be supplied.

SESSIONS

Sessions of the Standards Committee and the Governing Committee of the Sections, and the Society will be held on Tuesday.

Business and Professional Sessions of the Society will be held in the Auditorium on Wednesday and Thursday morning, afternoon and evening.

DINNER

Arrangements have been made with the Engineers Club, at 32 West 40th Street, for informal dinners on Wednesday and Thursday evenings, at 6.30 o'clock. Dinner tickets, one dollar each, may be obtained from the Registration Bureau before 5 o'clock on these days.

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DETAILS OF TENTATIVE PROGRAM

Tuesday, January 5

9 a. m. Meeting of the Standards Committee,* at the rooms of the Society, 1790 Broadway.

8 p. m. Meeting of the Governing Committees of the Sections, at the rooms of the Society, 1790 Broadway.

8 p. m. Meeting of the Council, at the rooms of the Society, 1790 Broadway.

Wednesday, January 6, 10 A. M. SHARP

In the Auditorium, Engineering Societies Building,
(29 West Thirty-ninth Street.)

BUSINESS SESSION

President's Address.

Treasurer's Report.

Report of Tellers of Election of Officers.

Report of Membership Committee.

New Business.

Report of Ball and Roller Bearings Division.—F. G. Hughes, Acting Chairman.

Report of Carbureter Fittings Division.—G. G. Behn, Chairman.

Wednesday, January 6, 1 P. M.

In the Auditorium, Engineering Societies Building,
(29 West Thirty-ninth Street.)

PROFESSIONAL SESSION

Recording Devices for Commercial Power Wagons.—Bruce Ford.

Report of Truck Standards Division.—Wm. P. Kennedy, Chairman.

*All members are welcome at this meeting.

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Report of Commercial Car Wheels Division.—Wm. P. Kennedy, Chairman.

Report of Electric Vehicle Division.—A. J. Slade, Chairman.

INFORMAL DINNER, AT 6.30 P. M.

At the Engineers Club
(32 West Fortieth Street.)

Wednesday, January 6, 8 P. M.

In the Auditorium, Engineering Societies Building,
(29 West Thirty-ninth Street.)

Pros and Cons of Correct Tire Inflation.—C. B. Whittelsey.

Report of Pleasure Car Wheels Division.—Henry Souther, Chairman.

Wire Wheels versus Wood Wheels.—R. B. Mudge.

Wire Wheels versus Wood Wheels.—Geo. W. Houk.

Report of Lock Washer Division.—J. E. Wilson, Chairman.

Report of Miscellaneous Division.—J. G. Utz, Chairman.

Thursday, January 7, 10 A. M. Sharp

In the Auditorium, Engineering Societies Building,
(29 West Thirty-ninth Street.)

PROFESSIONAL SESSION

Report of Electrical Equipment Division.—A. L. Riker, Chairman.

Railway Gasoline Locomotives.—A. H. Ehle.

Railway Motor Cars.—H. G. Chatain.

Warning Signals.—Alden L. McMurtry.

Report of Research Division.—David L. Gallup, Chairman.

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Thursday, January 7, 1 P. M.

In the Auditorium, Engineering Societies Building,
(29 West Thirty-ninth Street.)

PROFESSIONAL SESSION

Malleable Iron Castings.—Dr. Richard Moldenke.
Report of Frame Sections Division.—J. G. Perrin, Chairman.
Report of Iron and Steel Division.—Henry Souther, Chairman.
Nomenclature of Car Parts.
Allowances for Piston Fits.—E. W. Weaver.
Worm Gears.—C. T. Myers.

INFORMAL DINNER, AT 6.30 P. M.

At the Engineers Club
(32 West Fortieth Street.)

Thursday, January 7, 8 P. M.

In the Auditorium, Engineering Societies Building,
(29 West Thirty-ninth Street.)

PROFESSIONAL SESSION

Automobile Engineering Curricula.—Prof. W. T. Fishleigh.
Motor Car Testing.—A. B. Browne.
Report of Springs Division.—C. W. McKinley, Chairman.
Report of Standards Exchange Division.—K. W. Zimmerschied, Chairman.
The European Situation as Affecting America.—A. Ludlow Clayden.

MEETINGS COMMITTEE

JOSEPH A. ANGLADA, *Chairman.*
J. G. PERRIN,
E. T. BIRDSALL,
JOHN G. UTZ,
FERDINAND JEHLE.

Local Committee.

ROBERT MCALLISTER LLOYD,
ALDEN L. MCMURTRY.

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A BRITISH APPRECIATION

* * * * Having ourselves had experience of America's Society of Automobile Engineers, a body necessarily established on a much more important scale than is possible in these islands, one can say only that our smaller institution is working on the same lines that have brought such profit to the automobile engineers of the United States. The manner in which the sister institution across the Atlantic works has been a revelation to all who studied it, for it accounts in no mean measure for the solidarity and effectiveness of the motor industry of the United States as a whole and as a producer of a greater number of vehicles than all the other conutries of the world combined. These are early days yet for the Institution of Automobile Engineers of Great Britain, but the strides that have been made since Mr. Basil H. Joy took on the Secretaryship a few years ago are amazing. He is needed, for he has enlisted one after another of those big men of the movement who could never see any serious future for the Institution, in face of what may be styled its somewhat nebulous beginnings. To-day the organization is more than a body that has taken unto itself a name. It is the corporate spirit and body of the automobile engineers working in this country, and it besides has a special care for the automobile engineers of tomorrow, by reason of its graduates' section. We do not pretend for a moment that in the brief time at disposal it has been possible to go the whole length that has been achieved by the sister institution in America. On the contrary, the work would not be worth undertaking if the whole scheme of it could be accomplished in comparatively so brief a spell.

LESSONS FROM AMERICA

We have yet to learn a deal from the methods of discussion adopted by the automobile engineers of America on the occasion of their meetings, notably of the annual sort. The business-like method of their address is something that has not yet been matched in Europe, even in Germany, where, nevertheless, they stick very strictly to business. The fact is, many of us in Britain have to overcome a natural instinct to work each independently of the rest and to scorn anything that comes from the other man. In America it is not so. Her Society of Automobile Engineers is nothing less than a clearing house which every year thoroughly investigates every phase of automobile engineering development achieved in the country. Alike the papers and the discussions are masterpieces of practical investigation, with the minimum of personal prejudice and the maximum of information, particularly from a manufacturing point of view as distinct from

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mere theoretical vaporing. These remarks are made by way of encouraging certain quite distinguished British automobile engineers who in the past have had the honor of addressing their fellows at meetings, and who have been somewhat chary of revealing the whole of the inner workings of the particular phase of the subject which they have made their specialty. It is a point of honor with members of the American Society of Automobile Engineers that when enjoying the distinction of addressing their fellows they shall honestly lay before their professional brethren every in and out of that phase of the business on which their lifework is concentrated, for in that way, and in that way only, can things be learned and progress made. It is the big and the businesslike view. If you run an organization on those lines every member of it knows that, though he himself has time to attend at most only to one or two phases of automobile engineering, nevertheless because when his turn comes he gladly gives the fruits of such work to his fellows, so in turn he is awarded by others through being able to keep himself abreast of the fruits of all the latest work conducted along other lines of automobile engineering by the greatest experts in his country, because, when speaking, they also tell him the truth, the whole truth and nothing but the truth. What is the object of this? A fundamental recognition of the all-important point that it is good for any one automobile engineer or manufacturer of a given country that every one of his colleagues in that country should be as efficient an unit as possible, since the possibilities of good trade coming to his own firm must be always bound up in large measure with the general efficiency and repute of the motor engineering industry of his whole country.

BUSINESS BOUND UP WITH BROADMINDEDNESS

It does not pay any motor trader to see a rival producing and selling a bad article, because every such vehicle is a perambulating advertisement against automobilism. That is the basic principle of the American method of procedure. It is a principle very largely recognized in this country, but it is one which has yet to be turned into practice without a single exception among the motor engineers, too many of whom are still, unfortunately, small-minded, with that petty jealousy which is, perchance, the least attractive feature of the artistic temperament. A broader policy is a policy of profit all round. It results in that general leveling up which also makes each individual automobile engineer, no matter how brilliant he may be, still more brilliant than he would otherwise have been. * * * *

Automotor Journal (London, England), October 8, 1914.

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Presented at Metropolitan Section Meeting.

FACTORS AFFECTING TIRE WEAR

By L. Greenwold*

One of the causes of tire wear is irregularities in the wheel. Ordinarily the wear is more pronounced in one, two or three places on the tread, at the points where the wheel shifts most. The tread will wear through to the breaker fabric with very short mileage. Usually no partic-

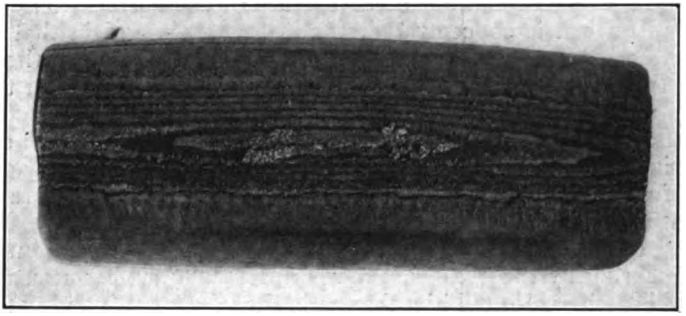

Fig. 1.—Tread wear occasioned by faulty alignment due to loose or worn hub disc, bent axle reach rod or knuckle, too long or too short cross rod or uneven tightening of demountable rim wedges.

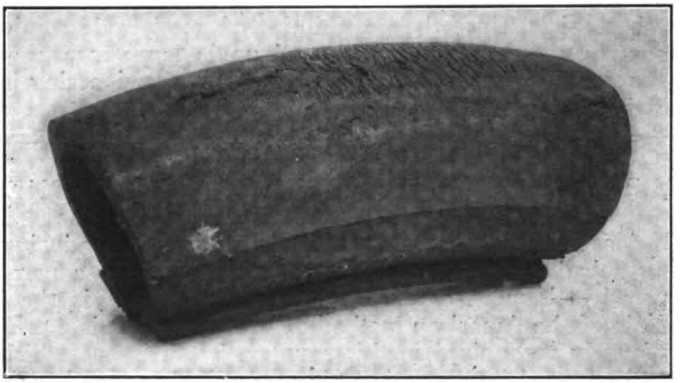

Fig. 2.—Effect of severe brake application, uneven brake adjustment or "fierce" clutch.

ular strain or injury to the fabric occurs. The tire may be made practically new by the application of a new tread.

Rough streets tempt one to drive in car tracks. It is more comfortable and it may be economy to protect the car at times by doing so and the tires will not be hurt much if it is only done occasionally. It

*Manager Service Department, Firestone Tire and Rubber Company.

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is the continued practice of running in car tracks that shortens the mileage. A tire which has the appearance of having been run in car tracks is frequently damaged by a protruding bolt under the fender.

A tire when underinflated is more elastic and resilient, due to the increased action of the side walls. This produces heat and softens the rubber cement on the fabric layers. When soft the tire runs against the

Fig. 3.—Damage caused by persistent driving in car tracks.

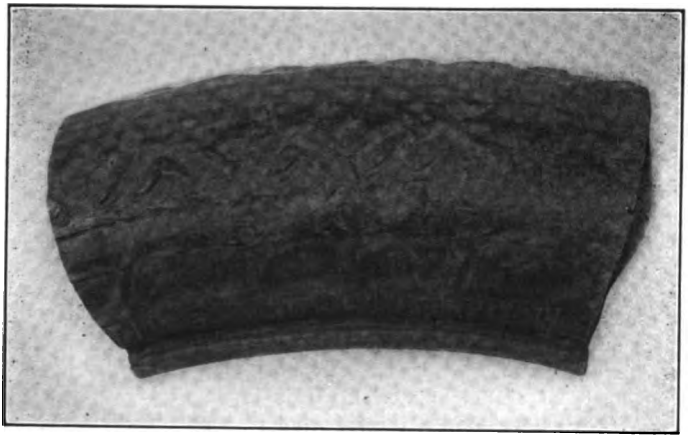

Fig. 4.—Chafing due to outside tread reinforcement.

"wave" in the tread rubber, producing excessive stretching and heating. Separation of the tread results. Another result is irregular tension of the various layers of fabric which will eventually chafe and blow out.

Ordinarily the tires on the front wheels should be inflated from 15 to 18 lbs. per inch of tire section and the rear wheels from 15 to 20 lbs. per inch of tire section.

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A successful tire must be properly designed with regard to shape, balance, strength, weight, resiliency and distribution of strain. Tread attachments or covers not only stiffen the tread to such an extent that hinging action in the side walls results in breaking the fabric, but also creep, chafe and cause heating. It is not unusual for the fabric to be burned from the heat.

Tire manufacturers treat the inside of casings with a solution to prevent the inner tube from sticking to the adhesive solution on the fabric. A good lubricant, however, should also be used. To reduce stretching and heating of the tube it should be free in the casing. If it sticks to the fabric the tube rubber is stretched too much and the life is quickly destroyed by the heat. Powdered mica or flake graphite should be rubbed into the pores of the tube and on the fabric inside the case.

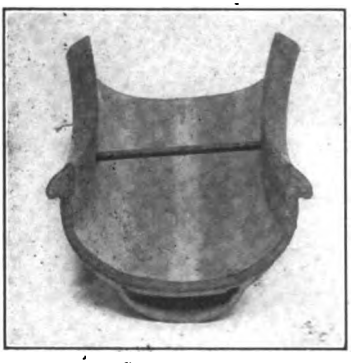

Fig. 5.—Separation of tread due to underinflation.

Fig. 6.—Chafing and heating effect caused by reliner.

If too much soapstone or talc is dumped into the tire it will collect in one place and heat to such an extent as to burn the rubber.

In order to secure the desired resiliency the side walls of the tire must be made of flexible material. It is impracticable to use a hard stiff wear-resisting rubber on the side and tires should therefore not be driven against curbs or in ruts. Vulcanizing new rubber on the sides or reversing the tire on the wheel when it is worn on one side only, will prolong the life of the casing.

Oil softens the cover of a tire and the traction strains then stretch the rubber into a wavy outline. It is only a matter of time before separation from the fabric will result. Oiled parkways and roads are not particularly harmful. The most damage is caused from allowing the tires to stand in pools of oil.

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The construction of beads has been so improved that running soft does not usually result in rim cutting. This trouble is more likely to develop from badly dented rims, overloading, tire fillers, etc.

Fig. 7.—Chafing due to insufficiently "filled" tire.

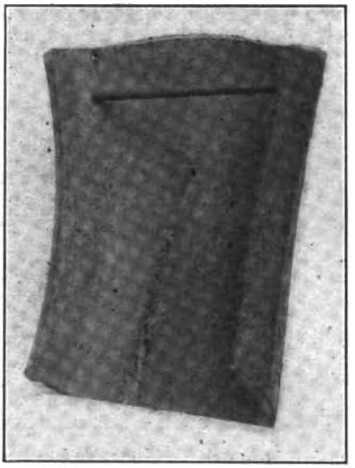

Fig. 8.—Damage caused by folded flap in careless tire application.

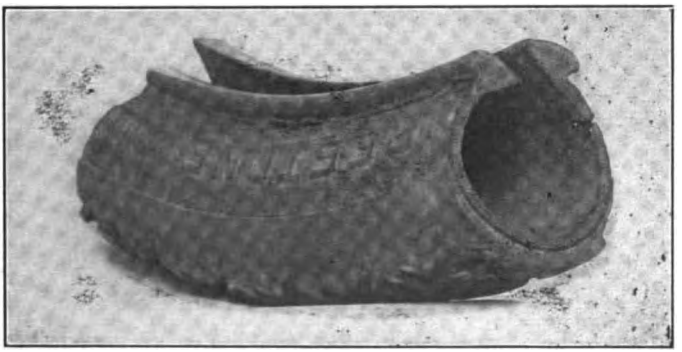

Fig. 9.—Effect-of-straight-side ring against clincher type bead.

DISCUSSION

L. GREENWALD:—Traveling at high speed, rubber heats up and stretches and becomes, in a sense, devulcanized, softening and grinding off very quickly.

ALEXANDER DOW:—What temperature of tires has been recorded under most severe racing conditions?

L. GREENWALD:—I cannot give any definite information on that. The tires become extremely hot. In one case I know of the rubber tread had

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been burned brown clear into the fabric, which, of course, indicated a great deal of heat.

ALEXANDER DOW:—Under ordinary tire conditions, that is, running pretty fast, I have recorded temperatures up to 130° or 150° F. I believe that tires really do not get as hot as some people think—not over 200° or 212° unless they are run deflated.

Fig. 10.—Wear due to driving in ruts.

Fig. 11.—Effect of undue use of anti-skid devices.

L. GREENWALD:—I think there is a wrong impression about the expansion. While the air increases a great deal in temperature, the expansion does not increase in proportion, as is the impression of some. There is no excuse for not inflating a tire in the summer-time so that it rounds out well.

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ALEXANDER DOW:—The increased pressure is about one pound for each increase in temperature of five degrees.

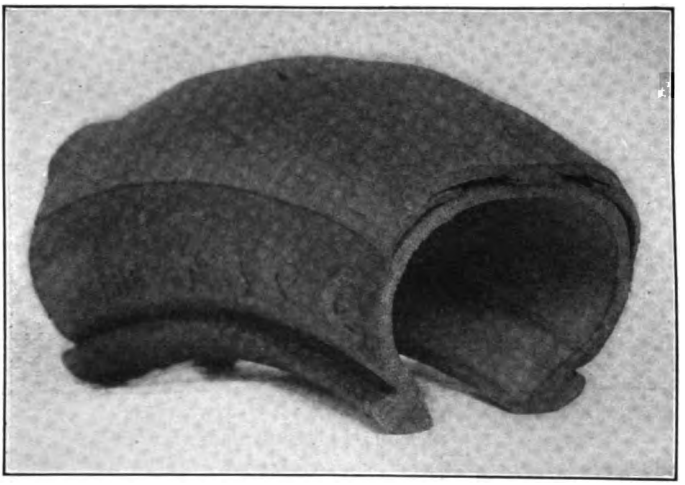

Fig. 12.—Deterioration caused by oil.

Fig. 13.—Chafed and bruised condition caused by running tire deflated.

Fig. 14.—Rupture of fabric due to overloading.

L. GREENWALD:—Increasing the temperature from 60° to 80° increases the pressure per square inch from 60 to 63 pounds.

MR. BASTEN:—Is there any benefit in putting six layers of fabric in a tire?

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L. GREENWALD:—On the right sized tire, yes; on a tire not large enough for six plies, no.

MR. BASTEN:—With a 4-inch tire we usually have five layers of fabric. Would it be a good plan to put six layers in?

L. GREENWALD:—No. In building the tire certain things must be observed. The tire must be correctly balanced, strong enough to carry the

Fig. 15.—Rim cutting due to badly dented rims.

weight it is designed for, but not be stiff; it must not be too thick or too heavy. Otherwise the tire will fail to give proper resiliency, fail to absorb the strain uniformly and break.

The general theory among tire users is that the tire manufacturer skimps a little on proper material. But it is very important to know where to stop. It is not an unusual thing to have a layman buy a tire and say "Now I want you to put a new tread on there—another tread right on top of this. I will pay for it." We say this is not a good thing. I have seen it tried a great many times.

MR. BASTEN:—Should a 34 by 4 tire contain five plies and a 35 by 4½ six?

L. GREENWALD:—That is the rule for making tires of these sizes. It is a rule of experience. In building a successful tire you may think it is just a matter of throwing materials together and curing them up to have a good tire if you use good materials. Understanding how to make a tire, you can take poor material and make a better tire than if you have good material and do not know how to make a tire.

I believe it is impossible to manufacture a tread extra cover of either the same material as the tire or any other material, which can be fastened so that it will work in unison with the tire. No matter how you attach it, there is going to be some friction and chafing action between it and the tire.

H. W. SLAUSON:—May I ask if flake graphite makes a satisfactory lubricant between the inner tube and the casing?

L. GREENWALD:—Flake graphite is the best known lubricant for tires,

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but relatively not nice to handle, as you know, and on that ground not especially to be recommended.

H. W. SLAUSON:—There is no danger of applying too much in that case, is there?

L. GREENWALD:—I think there is. To accomplish the desired results it is well to rub the graphite with a soft rag into the pores of the tube and then all over the fabric inside of the case. That is sufficient. Don't throw a lot of graphite in, because it will cause trouble if you do. Mica answers the purpose quite as well, and is nicer to use. Mica is used in the white solution with which the inside of tires is treated by the manufacturer.

ORREL A. PARKER:—I have made some observations of a tire running flat. The reason the tire breaks on the inside is, I believe, because the tire is between eighteen inches and two feet longer in circumference on the tread than on the bead; when a tire is run flat the bead is pressed down on the inside of the tread and you have the shorter circumference press down on the longer circumference. Therefore every time the wheel goes round you have a slipping of the beads on the inside of the casing under the tread. With a tire of 4-inch inside diameter, there is a difference of eight inches in diameter and something like twenty-four inches slip every time the tire goes around. So in addition to the flattening and breaking of the side walls, which would occur in case the car stood still, you have the slipping inside of the tread to a distance of twenty-four inches under the weight of the car every time the wheel goes around. I believe running a tire deflated for even a few revolutions causes more injury than running it a thousand miles fully inflated.

Presented at Metropolitan Section Meeting.

TIRE FABRICS

By HENRY VAN RIPER SCHEEL*

(Member of the Society)

In 1891 the pneumatic tire for bicycles had begun to replace the cushion tire, which in turn had replaced the solid tire. At this time the Brighton Mills began experimenting with cotton fabrics for tire purposes. Dr. Dunlop, in looking for great strength, had used linen fabric. The results obtained by using cotton were, however, very much better, and it was adopted rapidly.

Sea Island cotton replaced linen because with approximately equal strength it has a greater flexing quality, and also seems to withstand the vulcanizing process better. Furthermore, as a certain mill superintendent used to say, the Sea Island cotton fiber seems to have a peculiar self-lubricating quality, as between fiber and fiber, single thread and single thread—no doubt on account of the waxy envelope on each fiber.

*Brighton Mills.

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Many materials have been used, and in many sorts of construction, all the way from fabrics made of the finest silk to square woven fabric made of treated steel. The first fabric used in making bicycle pneumatic tires was cut into long strips with the warp and woof threads running peripherally around the tire and radially to the wheel, respectively. Then, to prevent the puckering wrinkles and unevennesses caused in forming the flat strips around the ring-shaped tire, special fabrics were woven in narrow widths, with pockets or flaps at the selvage edges to contain the wires at the rim, and with the threads at the center of the strip having less tension than those at the selvages, with the result that the warp threads at the periphery of the tire were longer than those next the rim. There were many variations of weave. All were fabrics designed to conform to Dr. Dunlop's specification: "with the circumferential threads at the tread stronger and close together, and at the side just sufficiently close together to hold the tread in position and prevent the air tube from being blown between the threads".

Then followed the use of square-woven bias-cut fabric with the warp threads and the filling threads of the same size and about the same number per inch. Such bias-cut strips were used in the same manner as the straight strips, but with much better results, because in this case, (1) both warp and filling threads take the strain more evenly; (2) there is less creeping and less heat-producing friction in the tire, on account of both ends of all the relatively short-length threads being firmly held at the rim; (3) the threads are mutually supported and mutually strain-resisting, suspension-bridge-wise; (4) the tires are stronger against driving strains, and faster; (5) they are more truly self-gripping on the rim, without undue tension on the peripheral threads.

Then followed also the use of thread fabric, or sheet of warp fabric, i.e., fabric with no filling threads, or only such very light threads as, having served to keep the warp threads flat during the handling, are easily broken when worked into the tire. In making the tire this thread fabric is laid in successive layers, "bias" in opposite directions, the result differing from the square-woven-bias fabric result in that the crossing threads are not interwoven or interlaced in any way, and are, consequently, straighter. On this account there is less heat-producing friction loss, and a speedier tire. This tire has had its greatest use in bicycle racing and on electric automobiles. Broadly speaking, Silvertown and Palmer Cord tires are of this type.

In about 1895 the development of the automobile made necessary the construction of stronger tires. At first the additional strength was obtained by putting in more layers of fabric, and later by increasing the thickness and strength of the fabric. The fabric which has now become standard for automobile tires is about twice as heavy as that used for bicycle tires. Although heavier fabrics have been made and used experimentally, it appears that for each class there is a point of best result where considerations of poorer breaking strength and poorer frictioning balance the lower cost of the fewer number of layers of heavier fabric,

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The kinds of cotton used to make tire fabrics are either combed Sea Island, combed or carded Egyptians, and, for the more indifferent uses, Americans. The genuine Sea Island cotton is that grown on the islands of the southeastern coast of the United States. The commercial Sea Island is grown in the counties along the coast of South Carolina, Georgia and Florida. Egyptian cotton is grown in the Delta, Middle and Upper Valley of the River Nile. American cotton, in its various grades (peelers, uplands, regular short staple stock, etc.), is grown in the southern part of the United States almost anywhere from the country back of the Sea Island country to the distant parts of Oklahoma, Texas and even Arizona.

Sea Island cotton is generally conceded to be the best for tire and all other purposes because it is stronger per unit of cross-section, finer, longer, and better protected as to waxy envelope. Among the influences which tend to make differences between the cottons, and even between the cottons from different portions of the same country are, (1) care in selecting the seed, (2) the method of cultivation, (3) climatic changes, (4) carefulness in ginning, (5) uniformity and carefulness in grading, and (6) commercial relationship between the ginner and the user, with its resulting closer understanding of the demands and needs of any particular trade. For instance, the growers of commercial Sea Island cotton are careful to obtain seed from the islands where the very finest grades are grown. In Egypt the selection of the seed is said to be under government advice and supervision. Egyptian cotton is thought to run more evenly from year to year than the Sea Island, because not only is the labor cheaper, but the climatic variations are less; moreover, irrigation facilities afford an opportunity of making up for an absence of water at critical times. For the reasons indicated above the character of the crop raised on the same land or in the same districts in successive seasons is not the same, so that in a particular year the crop may be "large and of good quality," "large and of indifferent quality," or "small and of good quality," etc.

In order to understand the importance of the considerations which are usually included in the specifications for a cotton purchase, i.e., length and strength of staple, uniformity of staple, cleanness of the cotton and absence of waste, a few words of explanation regarding cotton fiber and the early processes of cotton fabric manufacture may be given. The cotton fiber itself is a ribbon-like filament with twisted convolutions, of such relative diameter to length (in the case of Sea Island fiber) as can be imagined by thinking of a collapsed fire hose 1 inch thick and 130 feet long. The fiber is separated from the cotton seed by the ginning machine, which, in the case of Sea Island and the long staple cotton, is specially constructed not to injure the fiber. In this ginned cotton are fibers of full length and of shorter length, all more or less twisted and matted together, and mixed with particles of seed, pod, sand and dirt. In the finished thread are wanted clean fibers, all nearly parallel to each other, and stretched to the fullest extent parallel with the axis of the thread, without intervening foreign material of any kind. Short twisted fibers must have been re-

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moved because otherwise they would be taking the place of the longer fibers which, because of their greater length and holding power, make for greater strength. To get this result the ginned cotton must be cleaned, drafted to get the fibers parallel, and doubled to get evenness.

From the bale the cotton is passed through a bale-breaker wherein the pressure put upon the fibers in the making of the bale is relieved. Storage in large bins for several days affords an opportunity for the whole mass to age and to reach an average uniform condition as to temperature and moisture content. Then, led into pickers, it is fed to rapidly-revolving pin-studded or barred cylinders which further break apart the matted fibers, permitting an air blast to lift the light cotton to the outside of a revolving cage, and leaving behind, in the bottom of the machine, the sand, grit and heavy parts. In a blanket-like sort of lap the cotton is now fed to the card, where a set of circular-saw-like teeth takes hold of and throws the fiber upon the revolving cylinder and between it and the revolving flats, each covered with card clothing, where the fibers are teased apart and where small pieces of stem, etc., are caught on the points of the card clothing wires and removed. To get an average result, by doubling, the slivers from fifteen cards or so are led together at the sliver lapper, and to get a drafting to correspond, the cotton is led into the back slowest moving pair of rolls in the machine, then through three pairs of successively faster revolving rolls, the result being a thinner ribbon-like sheet in which the fibers have begun to be pulled into axial position. Next, into the ribbon laps, with further doubling and drafting to correspond; then to the combers, where most ingeniously such foreign particles as still remain and such twisted or knotted fibers as will not pass between the teeth of the fine combs are removed, as well as all fibers which are shorter than the certain length for which the machines are set. Here there is further doubling, with the proportionate drafting. Usually there are then used two or three sets of drawing frames, where the doubling and drafting is continued, as also at the slubbers, intermediate or jack frames, roving frames and spinning frames.

In the last-mentioned processes the diameter of the so-called sliver, or roving, or thread, has been gradually reduced until in the spinning frame there is produced at the front roll only so much cotton as is to go into the single yarn. The setting of (distance between) the rolls, which run at different speeds, is a matter of very nice adjustment; if they are set much wider apart than the length of the staple, weak and uneven yarn results; if they are set more closely than the length of the staple, filaments of cotton are caught under both of that pair, and with the front one moving faster, the fiber is broken.

We have seen, therefore, that there must be asked for cotton which as to its own filament is *strong*, not poorly nourished or rotted or mildewed or otherwise weakened; that it must be *long*, so as to have as much as possible of its length in friction contact with other fibers in the direction of the axis of the thread; that it shall be *clean* so as not to lose an

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undue amount of itself in the earlier processes; that its *waste* content shall be not great, so as to make the amount taken out at the combers and cards excessive; and that it shall be of *uniform character* as to all these considerations.

In the trade, Sea Island cotton is graded according to the foregoing considerations, as follows: Fancy, Extra Choice, Choice, Extra Fine, Fine and Common. The principal difference between the most costly grade, Fancy, and the next highest, Extra Choice, is not strength but the color consideration, which is not of much importance to tire fabric users. Accordingly, Extra Choice and Choice grades are those most often used. As has already been stated, the average cottons vary from year to year, and the gradings do also, so that one year's Choice cotton or Fancy cotton is not necessarily the same as another year's.

Single and Plied Yarns.—As we have seen, the carding processes are such as make for strength, uniformity and evenness in the single yarn. At the spinning frames for the first time a twist of more than just enough to carry the fibers is used. After this no drafting is possible.

The adequacy of the yarn can be determined by a strength test only when at least three other factors which affect the strength, namely, the amount of twist, the size of the yarn and humidity regain, are taken into account. Of course, it stands to reason that, other things being equal, the thicker the yarn the stronger it is. However, in order to get the desired results the count or number of the yarn can be permitted to vary on the average but very little from the standard. In the same way the breaking strength of a yarn varies with the moisture content; the wetter the yarn the stronger the break. Cotton is by nature very hydroscopic, and great care is taken to maintain manufacturing and testing conditions at a uniform degree of moisture density or humidity.

The twists used are "medium" and so chosen as to best combine the qualities of maximum strength with the necessary qualities of softness as to flexing power and as to rubber adhesion. When the single yarns have been twisted into the plied yarn, exactly the same considerations obtain, viz., strength and uniformity at standard conditions of twist, size and humidity regain. In the twisting the yarn may be fed to the revolving spindle either from separate spools or tubes or from a beam. The spindle may be gear-driven (without variation in slip) or band-driven; in the former case the yarn being "twisted before fed" and in the latter "fed before twisted." Although more costly, it is considered by many that the best results are obtained by twisting from separate tubes with a gear-driven flyer; "twisted before fed."

Cloth.—From the spools on which it was twisted the yarn is run on to section beams (big spools), and from several such section beams to a loom beam which goes to its place in the back of the loom. The pieces left on the spool are run off on bobbins to make filling or woof for the shuttles. In the cloth the considerations are those relating to, (1) strength, (2) uniformity of weaving, of crimps, of yarn tensions, of widths, gage thickness, etc., and (3) relative freedom from the imperfections which seem inevitable to some extent in the cotton industry.

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It may be stated in a general way that the item "strength" includes all others, that is, strength *in the tire,* because if the properly uniform tensions of thread to thread in the plied yarn, or plied yarn to plied yarn in the warp, or in the filling, or of the warp threads as a whole to the filling threads as a whole (relative crimp), are not present, then full strength is lacking. Also, if the width vary unduly, then at certain places there are more warp threads to the inch than at other places, which tends toward evenness and lack of strength. The leading tire fabric manufacturers feel that the place to make the fabric is in the loom, by the actual weaving together of the warp threads and filling threads in proper relation. Tire manufacturers should not be misled by the equally good appearance of fabric made with the aid of the steam jet and the heated roll on the calender.

Required Characteristics.

In any fabric there is one combination of the following elements which brings the best result, all things considered, viz.: Number of warp threads per inch, number of filling threads per inch, each of proper size and twist, these to make a fabric of the proper degree of openness for the frictioning rubber; and the relative crimps of warp and filling such (the crimp being the amount of take-up or shortening due to the interlacing of the warp and filling threads with each other) that the so-called "off-square" will be just enough to be entirely taken out by the operation of drying, frictioning, and rolling on the calenders in the rubber plant, this with the idea that the frictioned fabric when cut into bias strips ready to be built up into a tire will contain the warp and filling threads with equal crimps. A proper combination of elements in this specified manner will result in a fabric of a certain weight per square yard with normal humidity condition.

Building fabric is so designed that the rubber is pressed into the interstices between the warp and filling threads and forms a lock between the layers. Accordingly it may be considered that the porous fabric lies enmeshed in a sheet of rubber-and-fabric. To think of a layer of fabric with frictioned rubber spread on its top and bottom surfaces is inaccurate. Of course, fabric could be more closely woven, but it would not serve tire fabric purposes as well.

After being woven the fabric is very carefully examined in order that immediate correction can be made for any weaving or other faults which begin to make their appearance, and to trim up and make repair of such inequalities as exist in the roll. Then the roll is sent through a calender to be brushed and smoothly rolled into the shape in which it is shipped. It is felt that the cloth should not be ironed for the sake of appearance, or steamed and heated for the purpose of setting the crimps in the warp and filling, or for any other purpose.

Methods and Conditions of Tests.

Inasmuch as the quality of the fabric used in an automobile tire is one of the most important considerations to which the tire maker must give attention, there are necessary in the fabric mill systems of testing and

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inspection found probably nowhere else in the textile world. Every sample submitted and every package of raw material received must be tested, the product of each machine each day must be tested, and each roll of fabric must be examined, re-examined and tested in order that only the very best possible product will be delivered to the tire maker. Standard conditions of test have been developed for each of the foregoing, and in considerable detail. The necessity for this will be understood when it is realized that the breaking strength of a piece of fabric is comparable with that of another piece of fabric or with a standard only when it is known that the moisture content of the sample is what it should be as the result of sufficient exposure to an atmosphere of known temperature and relative humidity, that the sample tested was or was not recently submitted to a moisture bath, that it was fairly cut from neither end of the roll or from the selvage, that an exact number of threads are broken—a wider piece having been ravelled down to that number—that the jaws were of known shape, width and arrangement, starting a particular distance apart, the moving jaw moving at a particular rate per minute; also that correction of strength has been made on account of variation from the standard weight per square yard, and on account of variation from the standard per cent. of moisture content (regain).

Unfortunately the methods of test in use in the textile trade and among tire manufacturers are not uniform. However, some interest has recently been displayed by manufacturers and users of tire fabric in a standard specification and sale note, and it is hoped that in the near future there will be a clear, fair basis of understanding between the users and producers of tire fabric.

DISCUSSION

CHAIRMAN ANGLADA:—Mr. Scheel's paper is, I believe, the first on textile engineering that has been presented to the Society, and will prove very well worth careful reading by us who are not very familiar with the manufacture of cotton fabric.

ORREL A. PARKER:—If the yarn be twisted a little more tightly, a stronger fabric is produced. The reason it is not twisted a little more in tire fabric is so that the rubber in the calendar machine will properly friction the fabric and penetrate through it. Some years ago a prominent tire manufacturer made a tire with a closely woven tight-twisted fabric, which was splendid and strong as a fabric, but too closely woven for the rubber to go through and hold the tire together, so that the different layers of the fabric separated very quickly. Of course, this is clearly understood by those who manufacture tires, but to the layman it is not so clear, and I have often had them ask why a stronger fabric is not put in tires. I believe the fabric must be just so woven and the yarn of a loosely twisted nature so it will properly friction and so that when the tire is put together you will have a homogeneous mass of rubber with cotton fiber running through it, so that it does not loosen and the fabric become separated.

H. V. R. SCHEEL:—As to twist, there is a certain point beyond which

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you cannot go in making yarn. Excessive twist has the effect that when two hard-twisted yarns cross each other, as they do in square woven goods, they cut each other. There is a certain best point, a mean which has been determined by careful experiment.

W. L. LYALL:—When manufacturers first made automobile tires they used bicycle fabric, weighing perhaps eight and one-half ounces to the square yard and some slightly heavier. They then went to a thirteen ounce fabric very generally, having a very open weave, and found a disadvantage in it, inasmuch as in running it over the dry cylinders, and through the calendar, it was pulled very much out of shape. So they gradually came to the standard of seventeen and a half and seventeen and one quarter ounce goods, which is somewhat more closely woven. But they found that they could also go too far the other way and then would not get the good friction that they wanted and also that for the weight they did not get any excess of strength beyond a certain point.

ALEXANDER DOW:—I have heard of experiments that have been carried on for some time with the idea of frictioning the yarn before it is woven. When the regular fabric is calendared the rubber stock does not go between the individual threads.

H. V. R. SCHEEL:—I cannot say much about that, because it is more properly one of the problems of the tire maker. I believe that the Silvertown cord type of tire is made of cords built up of yarns treated with a rubber solution before being finally twisted together. Some work is being done on these lines now in another direction and it is possible that satisfactory results will be obtained.

SECRETARY POPE:—As I understand it, the principle involved is to prevent the effects of capillarity in the fabric. It would be interesting to hear the effect on pliability, and as to the difficulties involved.

W. L. LYALL:—Some years ago some tire makers tried out a vacuum method to impregnate the fabric much more thoroughly than can be done with a calendar. There was a bath through which the yarn was run. Open construction thread fabric that would allow the rubber to penetrate it much more thoroughly was used. I do not recall whether they merely put sheet rubber between the layers of fabric or calendared them as well. After they got the impregnated yarn into the tire they thought it prevented the slip of the individual fibers and that it was wise to have a little slip, on the principle of the camel's hair press cloth; the impregnated yarn made the tire too brittle.

E. FAVARY:—In relation to the strength of cotton and the maximum efficiency obtainable under a certain amount of stress, suppose we have duck with a strength of about 275 pounds per inch of width. In building a tire, suppose you stretch that duck by applying a tension of say ten pounds per inch of width. Would this tire last longer than if built up with a tension of one hundred pounds per inch of width of cotton duck? Which would make a better tire and at what tension does the fabric become weakened?

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H. V. R. SCHEEL:—I am sure I do not know. That is something for the tire man to tell us.

L. GREENWALD:—The question of stretch in tire fabric is very delicate. If the stretch be too much, the tire will be stiffer and become bruised much more quickly. Not stretching the fabric enough leads into manufacturing troubles. Every company has, I believe, its own views and factory methods as to what stress is suitable. In direct answer to the question as to ten pounds or one hundred pounds of tension, a hundred pound tensioned tire would not be worth very much. A bruise would blow it out very easily and it would be very stiff, not flexible. There must be some come and go.

W. L. LYALL:—How do you regulate that when you make tires by hand?

L. GREENWALD:—The correct length of each ply is determined in the cut and the man must pull it when he laps a certain distance to make the splice.

W. L. LYALL:—That would not be absolutely accurate; for instance, when you calendar the cloth, one roll might stretch more than another, be longer when it comes out, and narrower in width.

L. GREENWALD:—That is very true. There is the same problem in assembling tires mechanically. The stretch is different on the tread portion of the ply than on the sides. Our method of stretch is by machine tension.

E. FAVARY:—If you stretch a piece of duck, what is the critical point at which an excess of tension will injure the fabric? Differently stated, suppose we take just one yarn of a certain number of twists, which has a tensile strength of, say, twenty-five pounds; how much weight can we suspend from that yarn for a short interval without leaving a permanent stretch, or without causing injury?

CHAIRMAN ANGLADA:—That is, what is the elastic limit of the yarn?

W. L. LYALL:—There is no elasticity in a cotton fiber. We made a little specialty some years ago of camel's hair press cloth for hydraulic presses, for cotton seed and linseed oil mills. Sea Island cotton did not stand up because it had no elasticity. What we did find satisfactory was camel's hair yarn woven into the fabric. The hair fiber has an elasticity which cotton lacks entirely.

The only way to get anything approaching a stretch in cotton fabric is by the crimps. There is a certain slip before the fibers part entirely; that is all. A cotton thread made of Sea Island consists of a number of fibers that will average one and five-eighths inches in length, ribbon-like flattened tubes that have convolutions in them to enable them to grip each other, and that is all that gives strength to the threads; the twist tending to increase the grip of the different fibers to one another. That is helped by the humidity. We could not card cotton on a March day unless we had artificial humidification in our cardroom. The fiber would fly off the card surface.

We strive to give the same effect by weaving the goods specially in such a way that there is a certain off square between the warp and fill-

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ing. Mr. Parker has mentioned sail duck as being stronger. It may be. The crimp is the amount of takeup in the yarn and warp and filler, resulting from the operation of weaving in the loom. A sail duck that would not stretch and yet be closely woven was wanted. The best we could do was to get the warp crimped down to about twenty-two per cent. and the filling crimped down to about two or three per cent. In other words, the warp threads were so close together that we could not bend the filling threads at all to speak of and make good cloth.

But with the somewhat opened weave used in tire fabric, seventeen and one-fourth and seventeen and one-half ounce goods, we have a difference of perhaps three to six per cent. In other words, the crimp in the warp will vary from about twelve to fifteen per cent. The crimp in the filling will vary from about seven to ten per cent.

We had been aware of this desirable quality of square goods for a number of years, having had it brought to our attention very forcefully by the troubles of two of our customers who had neglected to consider it. They were using thirteen ounce, the first of the heavier weaves for automobile tires. To take care of a sudden great influx of business, they were running the calendars every day twenty-four hours. They could not get new calendars and naturally thought they would speed them up, which they did. This put greater tension on the fabric, so that goods going on to the drying cylinders, 42 inches in width in one calendar room were reduced in width to 39. That increased the crimp in the filling something like 7 per cent. The superintendent of the mill told me as a joke that he was making money out of our goods; we only sent him hundred-yard rolls and he was getting about 108 yards out of them. But the truth was he was taking nearly all the crimp out of the warp and putting more into the filling. Although the construction of the fabric was 22 x 22, we found that in the tire the filler threads had been reduced to 17 per inch and the warp threads increased to 24 per inch, notwithstanding which all the breaks were in the warp, the reason being that there was practically no stretch left in the warp (it was all in the filling).

ALEXANDER DOW:—I would like to ask what angle of bias cutting is found to be the best. I suppose the fabric is generally cut at 45 degrees, but I do not know whether there is any particular reason for this.

L. GREENWALD:—Practically all cut the fabric to 45 degrees, although various other angles have been used; thirty very much.

W. L. LYALL:—A neighbor called on us last spring to make some air-brake hose fabric the same as we had made for him some years before; his duck mill not being able to supply fabric that would give the required results. The reason was that the matters of crimp were not observed, and as a consequence the 45 degrees bias that was giving best results in the matter of bursting strains had to be departed from. To my mind, the fabric should be so woven and then handled by the tire makers that when cut on 45 degrees bias it will have equal crimp, in warp and filling. That is mechanically correct, according to my idea.

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WIRE WHEELS.

HERBERT CHASE:—A test was recently conducted under the auspices of The Automobile Club of America, in which five tires were used on a wooden-wheel car and an equal number on a wire-wheel car, the object being to ascertain difference in tire wear. One car followed the other, the cars alternating in leading and following on successive days, each covering the same distance, over the same roads. The drivers also alternated, so that conditions were the same for each car. Both were the same make and weight of car, except for the slight difference in the weight of the wheels themselves. The results were not altogether conclusive, because of the injuries to the tires which occurred. These had a marked effect upon their life. But by careful observation of the condition of the tires throughout the test we were unable to see anything in favor of the wire wheels over the wooden as affecting tire wear. As a matter of fact, the average mileage of the tires used on the wooden wheels was greater than that obtained from those on the wire wheels. But it was also a fact that the injuries to the tires on the wire-wheel car were rather more severe.

CHAIRMAN ANGLADA:—The wire wheel makers state that wire wheels are resilient and radiate the heat more readily. Of course, we all appreciate that the heat generated in a tire must be conducted down to the rim of the wheel in order to be radiated and that the chance of conducting the heat to the rim is rather remote. But it seems logical that there should be a greater fanning effect when the wheels revolve, due to the greater number of spokes in the wire wheel than in the wooden wheel. Now, is this cooling effect in the wire wheel of sufficint moment to affect the life of the tire?

G. L. MOSKOVICS:—The view is advanced by a wire wheel designer that on account of the lighter weight of the rim due to the absence of the heavy wooden felloe, the hammer blow on the tire is much less, and consequently the shocks, bruises and wear on the tire are less. That this is the greatest point affecting the economy of tire wear on wire wheels.

SECRETARY POPE:—Referring to the A. C. A. test, Mr. Chase spoke of the injury to tires on the wire wheels being more severe than those on the wood wheels. I would like to ask if there was any evidence in the records of the test that those more severe injuries were due to the fact that the wire wheels were less resilient than the wooden wheels.

HERBERT CHASE:—It is impossible to say. There was no conclusive evidence on that point.

SECRETARY POPE:—Did you have any clean blowouts in any case apparently due to shocks and the yielding of the fabric?

HERBERT CHASE:—Most of the blowouts appeared to result from striking some sharp object, although two or three tires failed as the result of their wornout condition, i.e., they were run to destruction, the failure resulting from the fabric wearing through.

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A DRAFTING ROOM SYSTEM

By B. L. MADDEN*

(Associate of the Society)

Parts are indexed alphabetically, numerically, and by assemblies by means of parts index cards, Form No. 51, and specification sheets, Form No. 52.

..20189..Tracing....A.....M..Date..Aug. 10, '12.....
..... Bushing.....
Material.....BB14 Casting.....Finish.....
Stock for One Part.....
.....
.....

Model	Req.	Where Used	Assembly
28	2	Gear Shifter Finger Bushing	21600
42	2	Gear Shifter Finger Bushing	21608
28	1	Water Pump Body Bushing	20779
42	1	Water Pump Body Bushing	20779
28	1	Water Pump Sprocket Cover Bushing	21241
42	1	Water Pump Sprocket Cover Bushing	21241
.....	.....	.....	.....
.....	.....	.....	.....

Parts Index Card—Form No. 51
4×6

Date..... Page.....

SPECIFICATIONS ....MODEL.....

Assembly No.....Name.....

Dwg. No.	Name	Material	Finish	Stock for One Part	Req.

Specification Sheet—Form No. 52
9×14

*Chief draftsman, Russell Motor Car Company.

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FORMS FOR SPECIFYING MATERIAL

Drawing Number	M — B	Name	Material	Finish	Stock for One Part	Req.
		Screws—Dia., Thread, Length, Kind of Head				
24×47	M	Air Tank Bolt	CS1	.....	$\frac{1}{16}$−24×1 Hex.	2
		Nuts—Dia., Thread, Kind				
18×42	M	Gasoline Strainer Bolt Nut	CS1	.....	$\frac{1}{16}$−24 Hex.	2
		Plain Washers—Inside Dia.×Outside Dia.×Thickness				
33×56	M	Shifter Fork Lock Bolt Washer	CS2 Stamping	.....	$\frac{11}{32}$×$\frac{1}{2}$×.120	2
		Lock Washers—Size of Bolt and Lock Washer				
33×63	B	Transmission Case Clamp Bolt Washer	SS41	.....	$\frac{1}{2}$ Lock Washer	2
		Cotter Pins—Diameter×Length				
20×29	B	Shifter Fork Shaft Cotter	CS1	.....	$\frac{1}{4}$×1$\frac{1}{4}$	1
		Taper Pins—Approx. Diam. at Large End×No.×Length				
20×67	B	Crankshaft Sprocket Pin	CS1	.....	$\frac{11}{32}$×No. 7× 2$\frac{1}{2}$ Taper	1
		Woodruff Keys—No.×Thickness×Diam.				
14×17	B	Countershaft Gear Key	NS22	.....	No. 29×$\frac{1}{8}$× 2	4

The parts index card original is printed on a tough grade of tracing paper (Eugene Dietzgen No. 177½ "Century Bond" being found satisfactory) and all entries are typewritten. Blue-prints are made with this original as a negative, and to make the lettering as nearly opaque as possible a black ribbon is used, with black carbon paper in back of and with carbon side toward the blank, thus securing an impression on both sides.

One number serves for both part and drawing, and also for pattern or die when such are required.

Two series of numbers are used, the first for all such parts as bolts, nuts, screws, etc., that are likely to be used in a number of different places, and are known as standard parts, and the second for all such parts as cylinders, crankshafts, etc., that serve some particular purpose and are not apt to be used otherwise.

Standard parts are so numbered that similar parts are brought together in the same group, the number constituting an index. A typical standard

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FORMS FOR SPECIFYING MATERIAL

Drawing Number	M/B	Name	Material	Finish	Stock for One Part	Req.
		Sheet Stock	*Thickness × Width × Length*			
23187	B	Battery Box Insulating Plate	Red Fibre		1/32 × 8½ × 24	1
20940	M	Steering Column Plate	CS1 Stamping	NP	.065 × 4½ × 7	1
		Bar Stock—Section × Length				
20299	F	Rear Shock Absorber Bolt	CS2	.....	½ Hex. × 2½	4
		Castings—	*Weight Before*	*Machining*		
20184	M	Transmission Cover	AL82	.....	5½ Lbs.	1
		Forgings—Stock	*× Weight Before*	*Machining*		
20096	M	Gear Shifter Finger	CS3 Forging	.....	2½ Lbs.	1
		Tubing—Outside Diam. × Wall × Length				
20815	M	Wire Carrier	CS3 Tubing	.....	1½ × .049 × 42	1

part number is 19X417, where 19 is the general group, 4 the sub-division, and 17 the number of the part in the sub-division; X simply showing that it is a standard part. Thus 19X may signify machine screws, 19X4 round-head machine screws, and 19X417 a 10-32 round-head brass machine screw ½ inch long. Each group allows of nine sub-divisions, and if more than this are required, two or more numbers are used for the same general group. Thus both 19X and 20X may signify machine screws. The probability of this being necessary, however, is very remote if the groups are properly chosen in the first place, care being taken that the name applied to any one group is not such as may have a very wide application. Thus, instead of bringing all screws together in one group they are separated into machine screws, cap screws, wood screws, etc.

Standard parts are traced on 9 x 12 sheets, Form No. 53, reference prints being made on 9 x 14 sheets, perforated to fit loose-leaf binding.

Parts are numbered consecutively, irrespective of the assembly to which they belong; that is, no particular effort is made to keep all the parts of any assembly in a single group of consecutive numbers.

All tracings are made on standard size sheets known as A, B, C, etc., sizes. The letter showing the tracing size of any certain part is entered on the parts index card directly after the word "Tracing." Thus, in looking for a tracing this letter shows where it is filed, as all tracings of any one size are, of course, filed together. Many parts are used of which we have no tracings, and this is shown simply by the absence of any letter.

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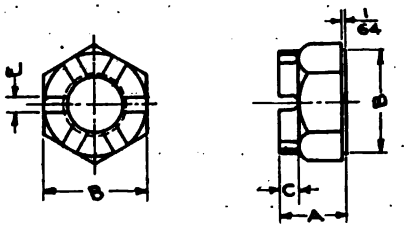

CASTLE NUT—S. A. E.

Drg.	Size	Pitch	A	B	C	E	COTTER PIN Size	COTTER PIN Drg.No.	Finish	Treat	Material
17x11	1/16	24	21/64	1/8	3/32	5/64	1/16x1/8	20x21		72	CSO

NAME OF FIRM

LOCATION

17x1

Change No.		Description	Date
A			
B			
C			
D			
E			
F			

Standard Part Sheet—Form No. 53
9×14

Whether a part is to be made, bought, or furnished, is indicated by the letter M, B or F just before "Date."

A "Make" part is one on which work must be done before it can be used.

A "Buy" part is one that is purchased completely ready for use.

A "Furnish" part is one the cost of which is included in the cost of some other part that is marked "Buy."

Many items, parts of the simpler assemblies, are never furnished for repairs, as it may be much more convenient to stock and supply only the complete assemblies. These parts are such that they can be both made and assembled to advantage in the same department, all of the work being

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done under a single order number, and no effort made to secure separate costs. Ordinarily these parts would be marked "Make," but in order that the production department may be informed that separate orders are not desired they are marked "Not Stocked" or just "Ns." This also informs one that these parts are not carried in stock.

After "Name" is entered the generic name of the part, a single word being used wherever possible to facilitate alphabetical indexing.

After "Finish" is entered either the heat treatment or finish, these and the material being specified by symbols which will be taken up later. Standard ways of specifying "Stock for one part" also will be taken up later.

Knowing the name or number of any part we should be able, from the parts index cards, to find complete information regarding it. A part may be used in a number of different assemblies, and in such cases the part number of each of these is noted, with a description of the part as used in that particular assembly. There are, however, certain cases in which a part is similarly used in all the assemblies of a given group, and to lessen clerical work exceptions are made of such. For instance, many parts are specified in all Chassis Assemblies of Model "28," which assemblies differ only in minor details occasioned by the different types of bodies, and it is then found expedient to omit all entries except those referring to Model "28 Touring."

Under "Req." is given the number of pieces required per car, which may or may not be the number required per assembly.

Double typewriter spacing is used to allow of notes being written in. When any particular application of a part is discontinued, a note to that effect with the date is made in the same space with and just above the existing entry. Similarly the word "Special" is written in when the part is not called for on the regular specifications. When all entries on any card refer to special parts the word "Special" may be written just below "Stock for one part" instead of repeating it on each line.

All specification sheets are typed in a similar manner to parts index cards originals, on 9 x 14 sheets, Form No. 52. The paper used is Eugene Dietzgen No. 135 "Vellum," cut to size and punched to fit loose leaf binders.

To use the specifications intelligently necessitates that one be familiar with the names applied to the various parts, and with the sequence of assembling operations. Each part is an item in some assembly, and all assemblies taken together and arranged alphabetically constitute the complete set of specifications. These are so written that each part is called for under the assembly in which it individually is used. Thus Water Pump parts will be found under "Water Pump Assembly," not under "Engine Assembly," and the screws that hold the water pump to the crankcase are under "Engine Assembly," the assembly in which these screws actually are used.

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The titles on all specification sheets begin with the word under which the assembly is indexed. Thus water pump assembly will be written "Pump—Water Pump Assembly."

Each assembly will call for all the parts or sub-assemblies of which it is composed, but will not call for the individual parts of those sub-assemblies. Thus, under "Engine Assembly" will be found Water Pump Assembly, but not water pump shaft, impellor, etc.

In the columns "Material," "Finish" and "Stock for one part" is given information by which the part may be readily identified. This information is not used for ordering by either the Purchasing or Stock departments, and so should be given in such form as will best serve the purpose intended, and for "Buy" or "Furnish" parts the "Stock for one part" often can be omitted.

In specifying the stock for "Make" parts the amount of material in the finished part is given, and no allowance made for "cut off," etc.

Under "Req." is given the number required per assembly, which may or may not be the number required per car. Thus, under "Cylinder Head Assembly" we find 2 cylinder head rings specified, and under "28 Engine Assembly" 4 cylinder head assemblies, showing that eight rings are required per car.

The object of this is to obviate the repetition of assemblies that differ only in the number of parts required. Thus, if the number per car were given, different cylinder head assemblies would be required for our models "28" and "42" respectively. One would call for 8 rings and the other 12, although the assemblies would be identical.

The Purchasing and Production departments will not be particularly concerned with this information regarding material, stock and number required, as they work from parts cards in conjunction with the specifications, which cards, it will be noted, give the number of parts required per car.

CHANGES

Changes are continually found necessary or advisable in order to improve the product, facilitate manufacture, or to correct tracings because of error or omission. When a change is made the utmost care should be taken to properly record it and to notify all departments concerned, as nothing is more apt to cause confusion in both office and factory than failure in this respect.

Changes may originate in any department, suggested changes being submitted to the Engineering Department on Change Requests, Form No. 54. The spaces marked "Drawing No.," "Requested by," "Date," "Name," "Description," "Reason," and "Signed" must be filled in on all change requests before being finally approved, those from the factory being signed by the Superintendent.

All changes will be approved by the Chief Engineer, usually after by his instruction any necessary tracing alterations are finished. If the

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Drawing No. .....20101..... Change Notification No. .....49.....

CHANGE REQUEST

Requested by.....*Final Test*.....Dept. Date.....3-19-'13.....

Name.....*Clutch Pedal Shaft*.....
Description.....*Change length of arm from 2½ to 2*.....
.....
.....
.....
.....
Reason.....*To increase leverage*.....
.....
Approved.....*MacDonald*..... Signed.....*B.L.M.*.....

Change Request—Form No. 54
4×6

necessity for the change is, however, quite obvious, it may be made at once by the Chief Draftsman, and not taken up with the Chief Engineer until submitted for final approval.

If the change is urgent a stock inquiry blank, Form 55, is sent to the Stock Department with the name and number of the part and the date filled in. The stock clerk enters the amount and condition of the stock for that part, and signs and returns the form to the Engineering Department. The lower part of the form is then used to advise the Stock

---

Part No.....20101..... Date.....3-19-'13.....

Name.....

A change is contemplated in above part. Advise the Engineering Department as to the condition of stock and stop all work on this part.

Finished	In Process and How Nearly Completed	Rough Stock
42	100—*3rd operation*	200

Signed.....*Smith*..... Date.....3-20-'13.....

Disposition of stock.....*Finish and use parts in process*.....
.....
.....
.....
Signed.....*B.L.M.*..... Date.....3-20-'13.....

Stock Inquiry—Form No. 55
4×6

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Department what disposal is to be made of the stock on hand. This often can be done by a rubber stamp by simply stamping "Imperative Change," "Engineering Change," etc., on the form.

In case the change is obviously not imperative and it is desired not to hold up production on the part, a line is drawn through the words "and stop all work."

Changes are classified as follows, the class depending on how the change affects finished stock:—

Imperative Change:

An absolutely necessary change. All work on the part must be stopped at once, the parts removed from all assemblies, store rooms, assembly rooms, and machine shop, and sent to the inspection room. If possible, they are made to conform with the changed print by re-machining, but if not, they must be scrapped.

Engineering Change:

A very desirable change, but one not absolutely necessary. If the parts in process can be finished to conform with the change this is done, but if not they are completed per the old print and used. It is left to the discretion of the factory whether or not to bring finished parts to date by re-machining, if this be possible. No parts are replaced nor any material scrapped for an engineering change. New parts added to the specifications are put in this class, and it will be noted that in this case the change takes effect at once, as there is no finished or partly finished stock to consider.

Drawing Change:

A change in the drawing that does not make any change in the finished part, such as adding dimensions left off by error, etc. A drawing change does not affect the specifications.

The above definitions apply in the great majority of cases, but it is sometimes found desirable to make special disposition of stock, and such cases are considered individually and decided upon by the Factory Manager.

Date..... No.....

SPECIFICATIONS AND DRAWING CHANGE NOTIFICATIONS

Approved by.....

Dwg. No.	Name and Description of Change	Disposition of Stock

Change Notification—Form No. 58
9×14

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The Chief Draftsman will stamp all change requests before being approved, indicating the class in which the change belongs. After being approved the tracings, with change requests attached, are given to the specification clerk, who will have them listed on Change Notification Sheets, Form No. 58. This form is printed on oiled sheets, cut and punched the same as specification sheets. Spaces are provided for the date, name, and number of the part, a description of the change, and the class to which it belongs. These sheets are numbered consecutively and must be signed by the Factory Manager before being blue-printed for distribution to the various departments. The notification sheet number is entered on each of the change requests to which it refers, which requests, after the changes have gone through, are filed according to drawing numbers. After the notification sheets have been approved the specification clerk will make the required changes on the specification sheets and parts index cards and put them aside for blue-printing.

SPECIFICATION BOOKS

Change notification sheets are sent out to give immediate notice of all changes, and to supplement the specifications. Specification books are brought up-to-date once every two weeks by replacing all sheets on which changes have been made. Thus, the specifications may fail to call for a part that was added two weeks before, but the attention of the different departments will have already been called to the addition by the notification sheets. The Purchasing and Production Departments, however, as will be shown later, receive revised parts index cards, giving correct specifications as soon as a change is put through.

The books of current specifications will contain only those assemblies that are actually being used at the time, together with such parts and assemblies as may be required for "Specials," which comprise all such equipment as sprags, bumpers, etc., not furnished regularly. A change sometimes requires that an entire assembly be discontinued, and in this case the specifications of same are removed from all books, except that belonging to the Service Department, and destroyed. The Service Department will thus have a record of all obsolete parts that they might be called upon to supply. The originals of obsolete specification sheets are preserved in the drafting room for possible future reference.

Complete sets of specifications are furnished to the Cost, Production, and Service Departments, and also a complete set in addition to the originals is kept by the Engineering Department. Any other department is supplied with specifications of such units as are assembled in that department, together with any others that actually may be required. In order that these various combinations of specifications may be kept up-to-date record is kept showing all departments to which copies of each sheet must be sent. This record is made on standard 4 x 6 plain ruled cards. The name and number of each assembly is typed on the top line, and below are listed the departments that require specifications of that particular assembly. These cards are filed alphabetically.

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CURRENT PRINTS

Record is kept of all blue-prints used for manufacturing or for ordering stock, whether sent to our own shops or to outside concerns. All current factory prints are filed in the tool crib and checked out the same as tools. Three prints of each detail and one of each assembly are usually found sufficient. More are supplied if required. These prints are charged out on Factory Print Order, Form No. 56, which, upon receipt of prints, is signed by the man in charge of tool crib. This form is used repeatedly when changed prints are sent to the shop and obsolete prints called in. When the tool crib cannot locate prints that are called in, note that they are lost is made on the original print order. Notice of lost prints is sent to the following: Superintendent, General Foreman, Tool Crib, Chief Engineer, and Chief Inspector.

In order to prevent a large accumulation of little used prints in the tool crib, all prints not called for on the current specifications are sent

No....23385....Name.....Muffler Outlet Pipe.....

No. of Prints	Date Sent	Received by	Date Recalled	Lost
3	4-22-14			

Factory Print Order—Form No. 56
4×6

from the drafting room only as required by the shop. These prints, which are used exclusively on obsolete models or on obsolete parts of current models, are taken care of as follows: All work on production is done on an order issued by the Production Department. If this order calls for a part not used on any current model it is sent to the Engineering Department, where the proper print, stamped with the order number, is attached and forwarded to the shop. These prints are used only on the particular order for which they are issued and are charged to that order. For charging, a book is used with columns for "Drawing No.," "Order No.," "Date Sent," and "Date Returned." When the work is finished the order and print are returned to the drafting room, the print destroyed, and the order sent to the Cost Department.

Prints not filed in the tool crib and required for reference or inspection purposes only can be obtained from the drafting room by the

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No....22332....Name..... Clutch Spring.....

Sent to..... W. D. Gibson Co. .....

Address.....Chicago, Ill.....

Ordered By	Received	Date	Notified of Change	Date	Returned
CHP	WJS	3-27-14			

Foreign Print Order—Form No. 57
4×6

inspector or Service Department. These prints are charged to the person receiving them.

A complete file of prints of all parts made from castings is maintained in the pattern shop.

Prints sent out for quotations and those sent to the factory for experimental work, and of which it is not desired to keep any record, are stamped "Not Recorded."

Orders for work other than that done in our own factory are known as "Foreign Orders" and prints for same are charged out on "Foreign Print Order," Form No. 57. This order is made out by the Purchasing Department and sent to the drafting room. The Purchasing Department receipts for the prints when received and the order is filed with factory print orders. When a change is made the original order is returned to the Purchasing Department for signature to show that they have been notified that the print is now obsolete, and if a new print is desired they will again sign in the "Ordered by" column.

Foreign print orders are printed on pink cards to make them easily distinguishable from factory print orders.

SPECIFYING MATERIALS

Materials are specified by name in all cases when such method is entirely definite, as "Lead," "Tin," etc. When the name of the material includes many different kinds such as steel, each is specified by a mnemonic symbol together with a number. Thus, CS-, CS1, CS2, CS3, etc., are all carbon steels but differ in chemical analysis; NS21, NS22, nickel steels, etc. Each kind of material will be completely specified by number, and the classes of materials are easily remembered by symbols. Numbers are allotted as follows:

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Carbon Steels	1 to 19	inclusive
Alloy Steels	21 to 39	"
Miscellaneous Steels (analysis not specified)	41 to 49	"
Iron	51 to 59	"
Brass, Bronze and Babbitt	61 to 79	"
Aluminum	81 to 89	"

All heat treatments are numbered, similar treatments being in the same group of consecutive numbers. They are then specified by the letter "T" in connection with the number, T1, T2, etc.

Finishes such as "Polish," "Nickel Plate," etc., are specified by writing the word out in full. The various enamels are numbered and specified by the letter "E" with the number. Thus E2 indicates the kind of enamel to be used, the number of coats, and the heat at which it should be baked.

To be Finished.....

.....

.....

.....

.....

.....

.....

.....

.....

Ordered by.....Date.....

Finished.....

.....

Work Card—Form No. 59
4×6

RECORD OF DRAFTING ROOM WORK

A record of all proposed drafting room work is kept on work cards, Form No. 59. This form provides spaces for:—

Date when work must be completed.

Description and sketch.

By whom and when ordered.

Date when finished and disposition; i. e., whether added to specifications, held for future use, etc.

As this work is taken up it is allotted by the chief draftsman, the cards being filed in a wall cabinet under the names of the various drafts-

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men. This enables each man at any time to see just what work he has ahead.

After new drawings are numbered and entered on the regular records, the work card is sent to the chief engineer to keep him informed as to the amount of work being done by the department.

PRACTICE

It is necessary that all parts be made strictly to blue-prints, and to simplify instructions to workmen regarding the reading of prints, all drawings are made uniform in respect to method of dimensioning, conventions, etc. The practice observed is, in general, covered by the following instructions and examples, which are rigidly followed.

Use only the following standard size sheets for all layouts, details and tracings:—

A— 9 x 12	D—24 x 36
B—12 x 18	E—36 x 48
C—18 x 24	F—36 x 72

Draw border line ½" inside of these dimensions.

Tracing paper and cloth cut to 18 x 24 and smaller standard size sheets, and with border line and title plate printed, is stocked.

Make all layouts full size if possible, never less than half size.

Avoid all unnecessary detail on layouts. Draw no more than absolutely necessary to show the construction, clearances, etc., until work has been approved.

Use third angle projection.

Give model, date, and signature on all sketches and layouts.

All threads are to be of the U. S. S. form unless made otherwise for some particular reason. The number of threads per inch must conform with the U. S. Bolt Standard for the softer materials such as aluminum, and with the S. A. E. Standard for the harder materials, such as steel.

Use Stub's Iron Wire Gage for all sheet metal wire and tubing, specifying the gage by its decimal equivalent.

All drawings must be completely dimensioned; fillets, chamfers, countersinks, etc.

Dimension as clearly and concisely as possible, omitting unnecessary notes.

When notes are required, show by lines terminating in arrow heads, to what they refer.

Give all dimensions in inches, but omit the inch marks.

Fractional machined dimensions allow a limit of ± .005 inch. Where dimensions must be held closer than this, specify the allowable variation by giving in decimals, both the maximum and minimum dimensions:—

$$\frac{1.625}{1.627}$$

When a part is to be finished by grinding after first being otherwise machined, two sets of dimensions are given:—

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$$\text{Turn}\ \frac{1.632}{1.640}$$

$$\text{Grind}\ \frac{1.625}{1.627}$$

Dimension from finished surfaces or from centers that can be easily measured on the finished part.

Arrange dimensions carefully, spacing adjacent parallel dimension lines uniformly and about 5/16 inch apart. Avoid crossing dimension lines unnecessarily.

Do not repeat dimensions in different views unless for some special reason.

All dimensions referring to operations done in assembly should be omitted from detail drawings, unless it is known that no assembly drawing is to be made.

Wherever possible have dimension lines serve also as the line between the numerator and denominator of fractions.

Indicate finish only where allowance for finish is made before the part is machined, not on parts that obviously must be finished during process of their manufacture.

Place finish marks with cross on line showing surface to be finished.

Tracers are to look over drawings carefully and see that they have a clear conception of the finished part before starting to ink in.

Make all lettering of the block type and of the following sizes:— Titles ⅛" high, notes 3/32" high. See lettering on separate sheets furnished.

Make outlines heavy enough to contrast well with center and dimension lines, which latter must be light but distinct.

Section lining may be put in freehand on pencil drawings, but in tracing lines are to be not less than 1/16" apart on all surfaces more than 3/16" in width.

Do not make tracings on a larger sheet than necessary. Long parts may be shown broken to reduce the size of the tracing.

On turned parts give dimensions on side rather than on end views.

Make arrow heads neatly and distinctly, and fill them in.

Dimension small radii, etc.

Where possible, dimension small holes on end view.

Dimension reamed holes in decimals.

Dimension taper pin holes, etc.

All threads are right-hand unless otherwise noted.

When part is to be finished all over mark tracing: FAO.

The following points will be observed in checking:—

Arrangement of views, neatness, and general appearance of tracing.

The likelihood of error is less if a tracing be carefully made and some thought given to the mere arrangement of dimensions.

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All necessary dimensions but no more.

The same point or line should not be located in a number of different ways, nor should the same dimensions be unnecessarily repeated.

Finish Marks.

Fits and Clearances.

Limits.

Title Plate properly filled in:

Name, No., Model, Material, etc.

Change No.	Description	Date
A		
B		
C		
D		

Note of changes is made in the upper right hand corner of the tracing. So that the change can be easily located on the tracing, the letters "A," "B," etc., are placed in ¼" circles near the parts or dimensions changed.

A standard drawing title plate is given below. It will be noted that space is left for the first model only on which the part is used. Its use on subsequent models will be taken care of on the parts index card.

Under "Material & Finish" are given also the Treatment and Sclerescope Test, if any. These are specified by the Metallurgist.

ALL MACHINED DIMENSIONS NOT IN DECIMALS HAVE A LIMIT OF ±.005

Name

Req'd.	Model First Used On		Material and Finish	
Drawn	Traced	Checked	Approved	Date
NAME OF COMPANY LOCATION			DRG. NO.	

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INSTRUCTIONS FOR BLUE-PRINTING DEPARTMENT

Keep files of prints in tool crib and pattern shop complete and up-to-date.

Send "Not Recorded" prints of all new "Make" parts to the tool design department.

Print and mail Change Notification sheets as soon as possible after same have been approved.

Print and deliver Parts Index cards as soon as possible after new parts are taken out or changes made.

Make prints for repair orders as received and deliver same to Production Department.

Make prints for foreign orders as received and deliver same to Purchasing Department.

Bring all specification books and standard parts books up-to-date at least once every two weeks.

CHANGES OF ADDRESS OF S. A. E. MEMBERS.

Alden, John L., formerly a student at the University of Illinois, Champaign, Ill.; now sales engineer, fan department, Oneida Steel Pulley Co., Oneida, N. Y.

Bell, John, formerly salesman, Marburg Bros., Inc., New York City; now connected with Norma Co. of America, New York City.

Billings, Cecil M., formerly experimental engineer and designer, General Motors Truck Co., Pontiac, Michigan; now chief engineer with J. M. Lansden, New York City.

Collins, John M., formerly factory manager, Knox Automobile Co., Springfield, Mass.; now connected with Moore Drop Forging Co., Springfield, Mass.

Davis, R. E., formerly in charge of automobile lecture work, Iowa State College, Ames, Iowa; now connected wtih Central Continuation School, Milwaukee, Wisconsin.

Denison, A. H., formerly connected with Bundy-Goebel Mfg. Co., Detroit, Michigan; now in the engineering department, Scripps-Booth Co., Detroit, Michigan.

Graham, Herbert J., formerly engineer, Jas. Boyd & Bros., Inc., Philadelphia, Pa.; now connected with Graham Mfg. Co., Longview, Texas.

Griswold, Roger W., formerly president, Cutler Hammer Mfg. Co., Milwaukee, Wisconsin; now president, Vulcan Motor Devices Co., Philadelphia, Pa.

Gurney, Erving R., formerly engineer, Martin Tractor Co., Springfield, Mass.; now assistant engineer in charge of design, Knox Motors Co., Springfield, Mass.

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Harroun, Ray W., formerly consulting engineer, Invincible Mfg. Co., Pittsburgh, Pa.; now chief engineer, Maxwell Motor Co., Detroit, Michigan.

Jardine, Robert, formerly general manager, Leap Resilient Wheel Co., Chicago, Ill.; now engineer, Rich Tool Co., Chicago, Ill.

Knowles, R. W., formerly engineer, truck division, Anderson Electric Car Co., Detroit, Michigan; now assistant chief engineer, motor vehicle department, Milburn Wagon Co., Toledo, Ohio.

Moffat, Alex. W., formerly handling service on Mercedes gasoline trucks, General Vehicle Co., Inc., Long Island City, N. Y.; now salesman, New York office, Commercial Truck Company of America, New York City.

Myers, E. A., formerly manager and secretary, Model Gas Engine Works, Peru, Indiana; now vice-president, Pittsburgh Model Engine Co., Pittsburgh, Pa.

Shonnard, H. W., formerly mechanical engineer, E. W. Bliss Co., Brooklyn, N. Y.; now mechanical engineer, Crucible Steel Co. of America, Harrison, N. J.

Thomson, H. F., formerly secretary, Research Division, Electrical Engineering Dept., Massachusetts Institute of Technology, Boston, Mass.; now with Provident Chemical Works, St. Louis, Mo.

Tillotson, H. C., formerly secretary, Stromberg Motor Devices Co., Chicago, Ill.; now president, Tillotson Mfg. Co., Toledo, Ohio.

Trask, Chas. A., formerly superintendent, American Mfg. Co., Chicago, Ill., now connected with the Rockwood Mfg. Co., Indianapolis, Ind.

Whalen, C. P., formerly factory engineer, Lehigh Valley Foundries & Mfg. Co., Easton, Pa.; now in charge of engineering department, Eiker Carbureter Co., Newark, N. J.

Woodhull, L. S., formerly designer, Studebaker Corp., Detroit, Michigan; now designer, General Service Engineers Co., Detroit, Mich.

APPLICATIONS FOR MEMBERSHIP

A list of current applications for membership is given below. The members are urged to send for the consideration of the Council any pertinent information with regard to those whose names are given which the Council should have prior to the election of any of the said applicants. It is requested that communications from the members in this connection should be sent promptly.

Chalfant, E. P., Secretary, Electric Automobile Mfrs. Assn., Chicago, Illinois.

Hansen, Hans Albert, in charge of Service Department, Stromberg Motor Devices Co., Chicago, Illinois.

Harrower, William, Mechanical Advisor and General Foreman, Brewster & Co., Long Island City, N. Y.

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Lane, Theodore T., Production and Service Engineer, Wichita Falls Motor Co., Wichita Falls, Texas.

Langston, Charles R., Manager, Kansas City Branch, Kelly Springfield Motor Truck Co., Kansas City, Mo.

McBriar, Henry C., Vice-president, Howell-Hinchman Co.; President, Hayes Co., Middletown, N. Y.

Miller, Joseph A., Treasurer, Rutherford Rubber Co., Rutherford, N. J.

Moore, M. LaBarre, Sales Manager, American Developing & Sales Co., Stamford, Conn.

Pollitt, John, Jr., Manager, Repairs Department, John Pollitt, Liverpool, England.

Russell, Philip S., Manager, Buick Motor Co., Philadelphia, Pa.

Shepard, Edward M., Engineer, Wagner Electric Manufacturing Company, Detroit, Michigan.

Waite, Edwin E., Chief Engineer and Factory Manager, Standard Woven Fabric Co., So. Framingham, Mass.

Wise, Edward M., Manager, Auto Accessories Dept., Toledo Rubber Co., Toledo, Ohio.

Young, Otto W., Draftsman and Designer, H. E. Wilcox Motor Company, Minneapolis, Minn.

APPLICATIONS APPROVED DURING NOVEMBER

MEMBERS

Batenburg, P. J. F., Four Wheel Drive Auto Co., Clintonville, Wis.

Fielder, Reuben E., 318 West 57th St., New York City.

Harley, William S., Harley-Davidson Motor Co., Milwaukee, Wis.

Kramer, Benjamin G., 1843 Mt. Elliott Ave., Detroit, Mich.

Massey, Hemsley B., 103 Park View Ave., Syracuse, N. Y.

Menderson, Edgar, 22 Forest Ave., East, Detroit, Mich.

Wahl, G. Adolph, 728 Prospect St., Indianapolis, Ind.

ASSOCIATES

Delay, Christian, 19 Chemin de Miremont 19, Champel, Geneva, Switzerland.

Drake, J. Walter, Hupp Motor Car Co., Detroit, Mich.

Harley, Leon J., Jr., Harley Co., Springfield, Mass.

Nagel, William G., 28 St. Clair St., Toledo, Ohio.

Parker, Willard, Pennsylvania Shafting Co., Spring City, Pa.

Ryan, Dan J., Allyne-Ryan Foundry Co., Cleveland, O.

Wright, Mortimer H., Pennsylvania Shafting Co., Spring City, Pa.

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Applications Approved During November—Continued

JUNIOR

Bull, Arthur A., 1038 Hancock Ave., W., Detroit, Michigan.

AFFILIATE MEMBER

Findeisen & Kropf Mfg. Co., Chicago, Illinois; Representatives, Kropf, Oswald F., Secy. & Treas.; Findeisen, C. W.; Rayfield, C. L., Chief Engineer; Rossow, E. A., Chicago Branch Manager; Robbins, W. A., Chief Draftsman; Motsinger, N. H., Jr.

STUDENT ENROLLMENTS

Faulkner, Fred L., 5544 South Park Ave., Chicago, Ill.
Simpson, Howard W., 22 Euclid East, Detroit, Michigan.
Skinner, Harlan C., 64 East 36th Place, Chicago, Ill.

OFFICERS OF THE SOCIETY

President, Henry M. Leland, Detroit, Michigan.

Vice-president, William Guy Wall, Indianapolis, Indiana.

Vice-president, K. W. Zimmerschied, Detroit, Michigan.

Treasurer, Hermann F. Cuntz, New York.

Chairman of Finance Committee, H. M. Swetland, New York.

Secretary and General Manager, Coker F. Clarkson, New York

MEMBERS OF THE COUNCIL

Henry M. Leland, Detroit, Mich.
William Guy Wall, Indianapolis, Ind.
K. W. Zimmerschied, Detroit, Mich.
Hermann F. Cuntz, New York.
Joseph A. Anglada, New York.
Harold L. Pope, Cleveland, O.
E. F. Russell, Longmeadow, Mass.
Christian Girl, Cleveland, Ohio.
Henry C. Wilson, New York.
Walter C. Baker, Cleveland, Ohio.
H. W. Alden, Detroit, Mich. (Past President).
Howard Marmon, Indianapolis, Ind. (Past President).

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SECTIONS OF THE SOCIETY

DETROIT SECTION

E. T. BIRDSALL.....*Chairman*
C. T. MYERS and W. N. OSBURN.....*Vice-Chairmen*
HERBERT L. CONNELL.....*Secretary and Treasurer*

(Address) 109 Webb Avenue, Detroit, Mich.

Meets first Thursday each month at 8 p. m., in the Employers' Association Rooms, Stevens Building, Detroit, Mich.

INDIANA SECTION

LON R. SMITH.....*Chairman*
R. H. COMBS.....*Vice-Chairman*
CHAS. P. GRIMES.....*Secretary-Treasurer*

(Address) Wheeler & Schebler, Indianapolis, Ind.

Meets first Tuesday after first Wednesday each month at 8 p. m., at the Hoosier Motor Club in the Claypool Hotel, Indianapolis, Ind.

METROPOLITAN SECTION

JOSEPH A. ANGLADA.....*Chairman*
HERBERT CHASE.....*Treasurer*
NIRAN BATES POPE.....*Secretary*

(Address) 1790 Broadway, New York City.

Meets last Thursday each month, except July and August, 8 p. m., at the Automobile Club of America, 247 West Fifty-fourth Street, New York City.

CLEVELAND SECTION

JAMES H. HERRON.....*Chairman*
H. B. ANDERSON.....*Vice-Chairman*
A. J. SCAIFE.....*Treasurer*
R. J. NIGHTINGALE.....*Secretary*
E. R. HALL, J. H. HERTNER, R. H. MANSON } ..... *Members Board of Directors*

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POSITIONS AVAILABLE

The following announcements are published for the information of members of the Society. No charge whatever is made for these announcements. Members who wish additional information will please address the office of the Society:

*167. Salesman, one that is capable of managing sales department, familiar with the automobile trade and of pleasing personality.

169. A high-grade retail salesman of moderate-priced pleasure cars for New York City proper.

189. Foundry foreman; one who can handle men and knows foundry business, especially in the cast-iron line.

*194. A well educated man for a position on the editorial staff of a leading motor vehicle trade journal. Must be a clear thinker, a good, easy writer with a keen appreciation of journalistic values. Must have a knowledge of finance, industry, transportation and economics. Engineering talent or at least an acquaintance with motor vehicle design and construction is essential. Must be willing to work under a prearranged editorial policy, able to produce high quality copy on scheduled time, and must know printing and engraving.

198. Want layout men with experience in heavy commercial vehicle design.

*199. Male stenographer having experience in automobile manufacture or supply house. Must be familiar with electrical details for motor cars. State details, references and salary in first letter.

*200. A good live man competent to take charge of automobile school. School has ample financial backing supported by both city and state. Salary from $1,500 to $2,000 a year.

MEN AVAILABLE

0280. Engine designer, competent to take charge of drafting room, design of complete car or experimental work. Ten years' experience.

0281. Chief engineer of prominent motor truck company, having just completed designs for full line of latest type trucks, is open for engagement.

0282. Chief engineer and designer in buildings, transportation, tools and construction. Long and valuable experience. Has specialized in indoor (warehouse) trucks.

0283. Production superintendent or assistant engineer; man who can design in consideration of present-day quantity production requirements and produce quantities at reduced cost.

(Continued)

*Send written application to S. A. E. office to be forwarded to employer.

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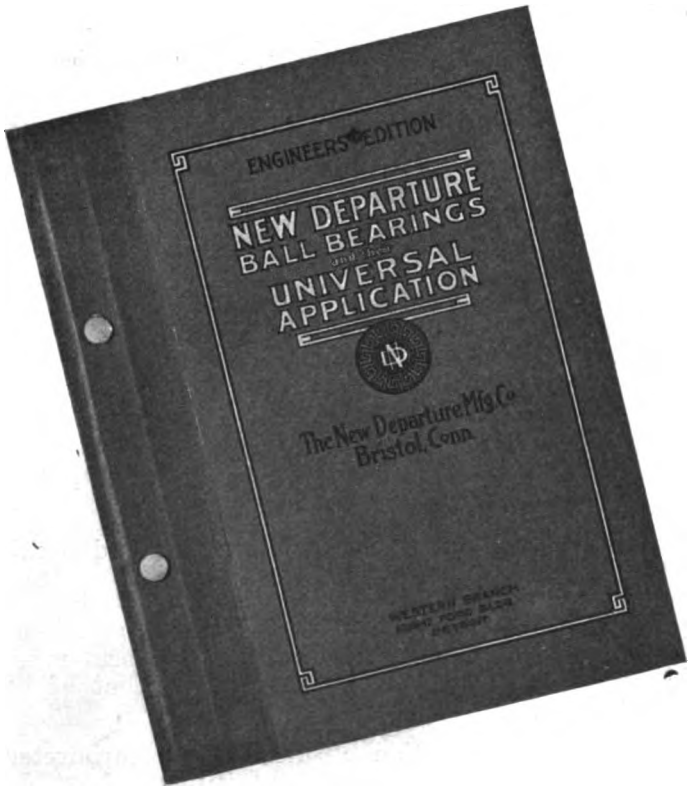
THE ENGINEERS' EDITION

NEW NEW DEPARTURE BALL BEARING CATALOG IS READY



In this book, published in loose leaf form with binder, will be found modern applications of Ball Bearings to parts of Motor Cars. No technical library is complete without it. *Send for a copy.*

THE NEW DEPARTURE MFG. CO.

BRISTOL, CONN., U. S. A.

Western Branch: 1016-17 Ford Building, Detroit, Mich.

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NATURAL FORCES

Applied in the

Browne Carbureter

The injecting force on a fuel nozzle is made up of two factors:

Force (a) The vacuum created by the suction of the engine.

Force (b) The velocity of the air flow passing the fuel nozzle.

Where air admitted through an auxiliary valve is governed only by (a) it does not bear the same relation to fuel flow under varying speed and atmospheric conditions, and, therefore, air/gas ratio cannot be maintained uniform.

Velocity is a constant, and is not affected by atmospheric conditions.

An auxiliary air valve actuated by (a) plus (b) admits air in direct proportion to the fuel flow, producing a mixture of constant air/gas composition under all conditions.

The Browne carbureter in that its fuel flow and auxiliary air admission are governed by the combined forces (a) and (b) differs materially from other devices in that it operates throughout its entire range on one comprehensive principle and maintains a constant and uniform mixture under all speed or load conditions, independent of barometric changes.

The fact that the action of the Browne carbureter is entirely governed by forces (a) and (b) is susceptible of proof, and we are anxious that engineers and manufacturers shall verify these calculations.

Formulæ and figures by which proportions and design through which to apply these combined forces have been obtained will be sent to every member of the S.A.E., and any others interested, free, without obligation, upon request to Holt-Welles Company, Inc.

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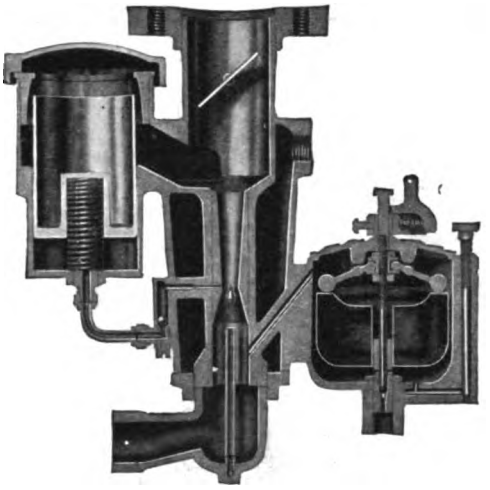

Thoroughness of workmanship and perfection of manufacture are characteristic of the Browne carbureter, which is made in a factory with equipment offering unlimited facilities for the production of carburetors.

The factory of the Malleable Iron Fittings Company, Branford, Conn., affords a capacity for the production of Browne carbureters in quantities to meet all requirements.

SOLE SELLING AGENTS:

Holt-Welles Company, Inc.

E. H. Stickels, President

U. S. Rubber Building **1790 Broadway** **New York**

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To the Motor Car Manufacturer:

We have the largest Top factory in the United States. We are building Tops for most of the largest Automobile Manufacturers today. We manufacture One-man Tops of our own patented design, which is without doubt the strongest and most durable construction on the market. It is so simple that it can be manufactured at a very low cost, which, coupled with our fine Organization of over nine years' experience in the Top building business, our up-to-date and efficient factory, which guarantees delivery and production, and our huge buying facilities, allows us to become the logical solution to the Manufacturers' Top question.

We are Specialists in the Top business and confident we can save you money.

We are at your service.

Yours very truly,

AMERICAN TOP CO.

Jackson, Mich.

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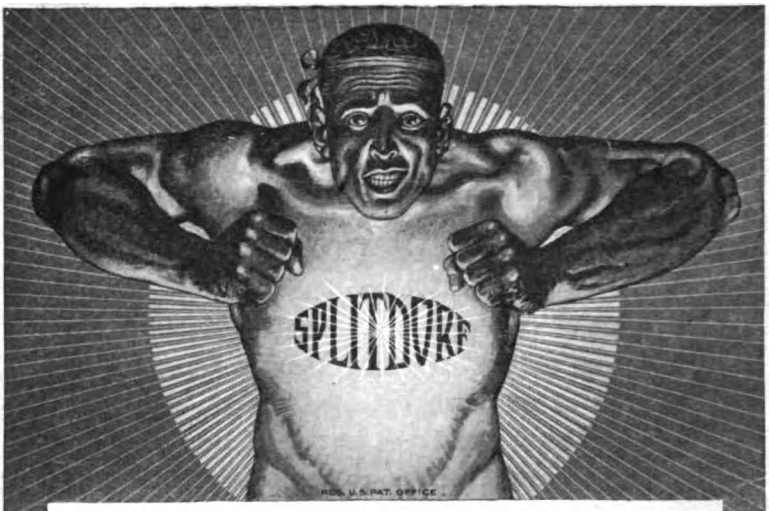

THE SPLITDORF ELECTRICAL COMPANY presents in their "Cunningham" Model "Six" a new type of water- and dirt-proof high-tension magneto whose range of spark advance extends over an arc of 70° and which is capable of producing flame sparks at the slowest engine speeds. It is constructed particularly for easy starting without the use of battery, auxiliary coils, or any external devices. The illustration gives an assembled view of the magneto (conforming to S. A. E. standards of measurement) showing water- and dust-proof construction.

In the lower figure *A* is a view of the armature showing the collector spool, bearings and circuit-breaker. *B* illustrates a sleeve construction mounted within the pole-pieces, rotatable with the advance lever. The armature *A* turns within the sleeve *B*. From this construction it will be seen that for any speed the break is always in the same position relative to the sleeve; that is, there is practically no difference in the strength of spark when the break is in advanced or retarded position, the speed remaining the same. By this construction an advance of 70° is obtained which is essential for long-stroke, slow-speed, six-cylinder engines.

Our Engineering Department is at Your Service

SPLITDORF ELECTRICAL COMPANY

NEWARK, NEW JERSEY, U. S. A.

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HAYES WHEELS
DEMAND
YOUR CONFIDENCE

Our plant is equipped with latest automatic machinery throughout.

Our wheelwrights have had life long experience in their work.

Our connections with the source of Timber Supply in the South are unsurpassed.

The Quality of our material is guaranteed.

WE CAN MAKE DELIVERIES

Hayes Wheel Company
Jackson, Michigan

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(*Continued*)

0284. Engineer and designer; seventeen years' European experience on all classes of vehicles, from light pleasure cars to heavy trucks, tractors and gasoline rail cars. Has studied necessities of design, from extensive road and repair department experience. Would consider sales or service end of business.

0285. Draftsman of executive ability with seven years' broad experience in the automobile line as layout man, designer and chief draftsman. Especially good on economical production. American, thirty years of age.

0286. Young man with four years' practical experience with motor car manufacturers. At present employed as designer and chief engineer. Desires position with large manufacturer. Has held positions in office, purchasing, drafting, laboratories and engineering departments.

0287. Engineer just returned from England desires position as engineer, chief draftsman or designing engineer. Ten years' experience.

0288. Young man, twenty-seven, eleven years' experience with foreign and American high-class cars. Expert on all classes of work. Excellent producer. Wishes to locate with progressive concern manufacturing either pleasure or commercial cars.

0289. Worker with ambition and push, getting results now as for years back, wants to exchange his experience and ambition for a nominal salary and a good chance to get ahead. Years of experience as superintendent, factory manager and purchasing agent.

0290. Would like to connect with research or experimental department of an automobile or accessory builder. Am now holding a responsible position with a well-known company and desire to change only on account of preferring the above-named work. Several years of valuable experience. Exceptionally good on electrical equipment. Quick and accurate in technical work. Married. Age 30.

0291. Managing and designing engineer in high-class construction desires position with large and progressive concern; 35 years of age.

0292. Engineer, 32 years old, desires responsible position with automobile, motor or accessory manufacturer. Twelve years' thorough practical training with large companies.

0293. Sales engineer with broad technical training and practical experience in sales, engineering and production, now handling ignition, lighting and starting equipment for automobiles in Detroit territory, desires opportunity of larger scope in this or other accessory line.

0294. Graduate mechanical engineer. Experience in motor and chassis design, experimental work and general production. Has initiative and resourcefulness. Would make capable assistant to chief engineer, production manager, etc. Location in eastern states preferred.

(*Continued*)

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The Goodyear No-Rim-Cut Tire

Power Saver Type

The Original American Cord Tire

Here is the tire for those motorists who place special importance on the advantages of comfort and low power consumption—whether for electric or gasoline vehicles.

The Goodyear Power Saver Cord Tire has been developed especially to meet these requirements. Yet durability has not been sacrificed for resiliency.

Thirty-five per cent more resilient than regular tires at 20 miles per hour.

More resilient than any other cord tire by actual test, based on power consumption of tire alone.

Durability rivaled by no other cord tire and by few tires of any type. Such is the verdict of hundreds of actual tests of our latest and most perfect design, both in the laboratory and on the road.

Our Experimental Department, with its volumes of data and complete equipment, will be glad to co-operate with you in working out your requirements. For exact details address Desk 106.

GOODYEAR
AKRON, OHIO
Cord Tires

THE GOODYEAR TIRE & RUBBER CO., AKRON, OHIO

Makers of Goodyear No-Rim-Cut Automobile Tires

(2101)

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(*Concluded*)

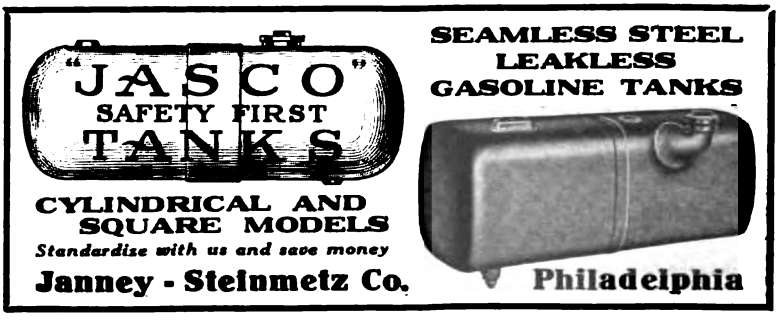
0295. Engineer, having 16 years' experience in designing all parts of automobiles. Gas engine a specialty. Thirteen years in general manufacturing. Has been chief engineer of a large automobile factory for the past eight years. Will be open for a position Dec. 1st.

0296. Draftsman; eleven years' drafting experience, five designing commercial cars, high-grade and light pleasure cars. Can qualify as layout man. designer, checker or chief draftsman. Would prefer situation in middle west. Twenty-eight years of age.

0297. Designing and manufacturing engineer on medium-priced pleasure cars wants chance as works manager, engineer or superintendent. Fourteen years' practical and theoretical work. Technical graduate in mechanical engineering.

0298. Engineer-writer with long and varied practical experience as designer and constructor of trucks and pleasure cars and in editorial work with a number of trade papers, desires large opportunity in an advertising department, preferably with a firm building both cars and trucks. Write advertising, publicity, catalogs in English and Spanish, booklets, repair parts lists, instruction books, edit house organ, etc. Complete knowledge of printing, engraving, paper, type, etc. Eastern location preferred.

Gray Iron Castings
The monthly output of our machine shop is 35,000 cylinders. In addition to our very large and complete foundry we have an extensive machine shop for the machining of gray iron castings and other motor car parts with accuracy and uniformity.
If you want to save yourself money and worry by an absolutely reliable source of supply, write us today.
THE FERRO MACHINE & FOUNDRY CO
CLEVELAND, OHIO
FERRO



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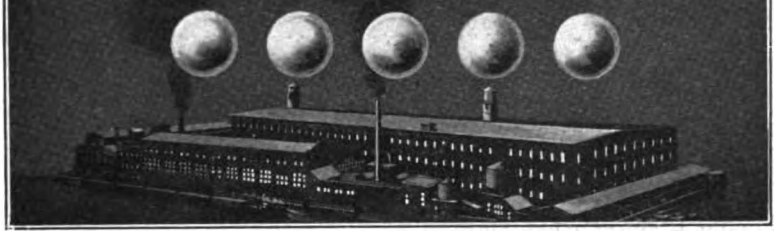
America Takes the Lead In Ball Making—

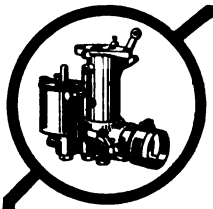
We are working nights to supply the demand, for we are the only manufacturers on this continent that can turn out balls equal in every respect to the European product. Not only are Atlas Balls guaranteed round and true to size within 1/10,000", but for extreme hardness, toughness and resistence to shock, we believe we can state without fear of successful contradiction that they excel any ball make in the world, and we stand ready to prove this claim.

MADE IN AMERICA

ATLAS BALL COMPANY

209 Glenwood Avenue Philadelphia





FOR SEVEN YEARS

unchanged in principle, Baverey's brilliant invention, the Compound Nozzle, has given perfect carburetion with great simplicity of parts.

ZENITH CARBURETOR CO.

DETROIT, U. S. A.

STANWELD

Stanweld Rim

No. 20—Equipment on these cars

Chalmers	*Kissel*	*Pathfinder*
Dodge	*Lewis*	*Peerless*
Dorris	*Mitchell*	*Pilot*
Empire	*Moon*	*Reo*
Hudson	*Overland*	*Richmond*
King	*Stearns (light four)*	*Westcott*

The Standard Welding Company

Main Office and Factory: CLEVELAND

NEW YORK CHICAGO DETROIT

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FILL OUT AND SEND TO S. A. E. OFFICE

SECRETARY,

SOCIETY OF AUTOMOBILE ENGINEERS,

1790 BROADWAY, NEW YORK CITY.

Please send application blank to

.....

NAME

.....

POSITION AND COMPANY

.....

ADDRESS

whom I consider eligible to S.A.E. membership.

.....

S. A. E. MEMBER

.....

ADDRESS

The NEW **KELLOGG** Motor Driven Tire Pump

A Selling Factor of Recognized Merit

The Standard by which Other Pumps Must Be Judged

ALL METAL EVERLASTING CONSTRUCTION. A GUARANTEE AGAINST OIL SPRAY IN THE AIR. Good enough for the most expensive car. So reasonable in price that it can be included in the equipment of medium priced cars.

Write for Our Specifications

KELLOGG MFG. CO., Rochester, N. Y.

NEW YORK CHICAGO BOSTON DETROIT SAN FRANCISCO

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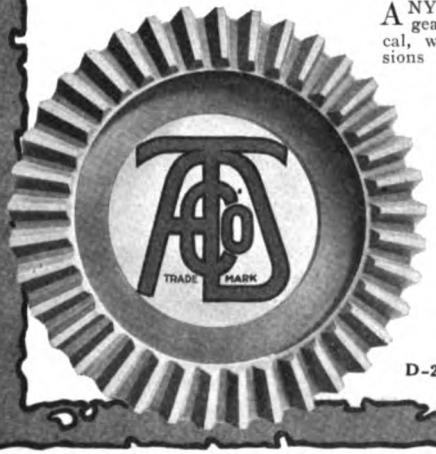
GEARS TRANSMISSIONS REAR AXLES



ANYTHING in *guaranteed* gears—spur, bevel, mitre, helical, worm. Complete transmissions and rear axles from our successful standard designs or from your own drawings. Our up-to-the-minute equipment assures *service* at the right prices. A postal is enough for further information or estimates. There'll be a welcome and a live exhibit for you at space D-214, New York Show.

AMERICAN DIE AND TOOL CO.
Reading, Pa.
D-214 New York Show

JACKSON RIM COMPANY
JACKSON, MICHIGAN
Exclusive manufacturer of the
DETROIT DEMOUNTABLE RIM
Builders of all types of Standard Clincher Rims
We will make announcement of interest relative to Rim Construction in the December issue of the S. A. E. Bulletin

The Michigan Electric Welding Co.
DETROIT
Specializes on fore and aft steering reach rods (drag links) and brake rod assemblies.
¶ The drag link, particularly, is an item that should receive most careful consideration—the control of the car depends on this member. Ours is an all seamless steel tube construction, and carefully worked out as to detail.
¶ Let us consult with you on this important part.

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Members are requested to advise the S. A. E. office promptly of change of address, using form herewith:

SECRETARY,
SOCIETY OF AUTOMOBILE ENGINEERS,
1790 Broadway, New York City.

Please change my address now appearing on your records, to the following:

Company connected with.....

Profession or Position.....

Address of Company.....

Address for Mail.....

Articles Manufactured.....

.....

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Very truly yours,

.....

S. A. E. Member.

New Process Gear Corporation

Cut Gears of Quality
Complete Differential Gears

Syracuse, N. Y.

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THE WYMAN & GORDON CO.

Worcester, Mass. AND Cleveland, Ohio

MANUFACTURERS OF

GUARANTEED FORGINGS

If you have thought it necessary to import forgings and your supply has been interrupted, we guarantee to duplicate any service in forgings made anywhere, of any steel

STAMPINGS

FOR AUTOMOBILE PARTS

No matter how difficult your automobile part stampings are, we can make them for you the way you want them made. Our special equipment enables us to produce light and heavy sheet metal stampings of highest quality

G.P.&F. Service

KNOWING HOW SINCE 81

Send samples of blue prints and let us estimate on your hoods, covers, joint cases, pans, drums, shells, housings, clutch cases, etc.

Geuder, Paeschke & Frey Co.,
1365-1700 St. Paul Ave., Milwaukee, Wis.

DIXON'S 677

GRAPHITE TRANSMISSION and DIFFERENTIAL GREASE

Is a form of insurance against wear, noise and trouble due to inadequate lubrication. Send for "Lubricating the Motor" No. 95. Made in Jersey City, N. J., by the

JOSEPH DIXON CRUCIBLE COMPANY

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PRESSED STEEL AUTOMOBILE FRAMES

Originators and manufacturers of Heat-treated Frames

PARISH MANUFACTURING COMPANY

DETROIT, MICH. READING, PA.

MOTOR DU PONT FABRIKOID QUALITY

REG U S PAT OFF

IS GUARANTEED TO OUT-WEAR COATED SPLITS

It is replacing splits in the upholstery departments of several of America's largest auto manufacturers. Our top material is unsurpassed. Get a FREE SAMPLE and test it.

DU PONT FABRIKOID COMPANY

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Breakage is distortion of crystals accomplished by bending beyond the point of elastic limit, and may be caused by little distortion frequently or much distortion infrequently.

Imagine what will happen to point "C" if "A" is deflected little but often. It will result as shown at point "D," where 220 tons were applied and when released, the arm broke.

Can this happen in Figure 2 or 3? With arch construction without joints between rim and spoke, and two flanges that vibrate each shock, not between two spokes only, but over its entirety, thus lessening shocks, this COULD NOT happen. SHOCKS ARE MINIMIZED BY SCATTERING.

The Dayton Steel Foundry Co.

Dayton, Ohio

NOTE DEFLECTION
Figure 1

Figure 2

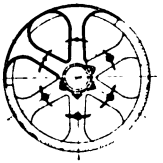

Figure 3
The most resilient truck wheel, point for point

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Foundry under absolute Laboratory control.

No guess work in annealing.

Sometimes it takes months, sometimes even years for a motorist to come around to buying Kelly - Springfield Tires. That's because some people have more patience than others.

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Corner Broadway and 57th Street, New York

Branches and Distributors in All Principal Cities

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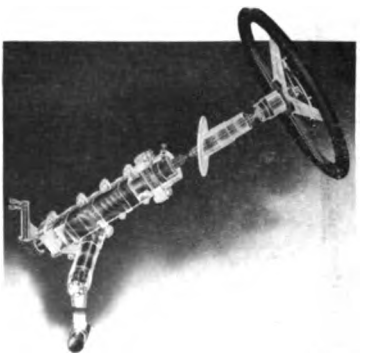
of a new design are
being built by the

Ross Gear and Tool Company



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We also specialize in quantity production of
REAR AXLE HOUSING ASSEMBLIES,
DROP FORGINGS & SPECIAL STAMPINGS

A. O. Smith Company
MILWAUKEE

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COLD DRAWN OR TURNED

- Shafting, Axles, Piston Rods.
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THE SUCCESS of the Link-Belt Silent Chain is due almost entirely to the superiority of its joint construction. The segmental liners or bushings, which are removable, extend across the entire width of the chain, thus doubling the bearing surface and halving the bearing pressure on the joint. The bushings (or liners) are case-hardened, and bear upon the case-hardened pin. The latter is free to, and does rotate with reference to the bushings and presents every particle of its surface for wear. As a result it wears uniformly, keeps round, and the chain maintains to the end its high initial efficiency. (98.2 per cent. on actual test.)

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Consider, from an engineer's viewpoint, the fact that the cars that have won all the important races of recent years have carried magnetos equipped with "NORMA" Ball Bearings. You know what that means, in the way of bearing service. Consider what it means as to "NORMA" speed qualities.

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"NORMA" *Ball, Roller, Thrust and Combination Bearings*

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4-Cylinder

Westinghouse Electric Ignition includes automatic spark control, providing:

Accurate firing; maximum horsepower; maximum speed; minimum fuel consumption; minimum wear in engine due to correct firing; minimum attention to driving.

Westinghouse Electric Ignition combined with Lighting Generator, means:

Single unit; single drive; minimum weight; minimum installation cost; simplicity of power plant.

Westinghouse Electric Ignition includes Ignition Coil in Generator:

Self-contained; minimum wiring; minimum inductance; maximum life of contacts; accessible; clean dash.

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"Chesterfield Six"

AND MANY OTHER CARS.

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TRUCKS AND PLEASURE CARS

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This Manufacturer Was Convinced

Recently a large manufacturer of automobiles ran a sealed motor oil test. He tested 14 oils which remained unidentified until the test was over. The comparison of TEXACO MOTOR OIL and the next best are given below:

RECORD OF TESTS

Tests were made on two motors on testing block, followed by road tests. Summarizing the report of the block test over test period:

Quantity Used:
Texaco Motor Oil, one gallon used.
Competitive oil, one and one-quarter gallons used.

Carbon:
Competitive oil showed considerable hard carbon on both heads and inside valve ports, having caked on one valve ⅛-in. thick. Carbon had to be scraped and chipped off.
Texaco Motor Oil showed very little carbon, and that little was soft and easily removed with rag.

Valves:
Competitive oil showed these quite DRY when removed.
Texaco Motor Oil showed these valves wet with lubricant.

Spark Plugs:
Competitive oil showed slight amount hard, dry carbon.
Texaco Motor Oil showed slight amount of soft, wet carbon.
Sparking not interrupted in either case.

Cleaning motors for second series of tests, several hours consumed in scraping carbon from valves and piston using competitive oils. A few minutes only required to clean motor using Texaco Motor Oil.
Following the block tests, road test was made for 532 miles with same motors as used in block tests. These tests bore out the conclusions reached in the block tests, showing greatly in favor of Texaco Motor Oil.
He was easily convinced of the superiority of TEXACO MOTOR OIL.

Should you want to hear further details, drop us a line and we will be pleased to write you fully.

TEXACO

THE TEXAS COMPANY

Department "S"

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The pioneer and recognized leader in electric starting, lighting and ignition apparatus.

THE DAYTON ENGINEERING LABORATORIES CO.
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Wagner Quality

THE STERLING MARK OF THE ELECTRICAL WORLD

The remarkable efficiency of the Wagner Starter is due to the fact that it is designed and built especially for the car it is to equip.

No two makes of engines, even with the same stroke and bore, have the same cranking requirements—no two need a starter with identical characteristics. Any starter adapted to two or more makes of engines must necessarily be a compromise.

The Wagner Company will be glad to send an experienced engineer to discuss with you the desirability of having a Wagner Starter designed and built for the car you are building.

Wagner Electric Manufacturing Co.
St. Louis

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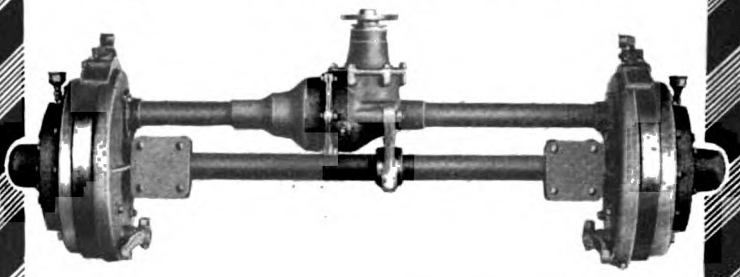
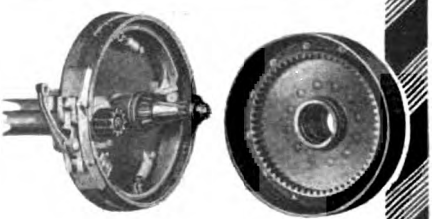
Russel

Internal Gear Drive Axle for One Ton Truck



FOR over a year our Engineering Department has concentrated its entire attention on the development of the one ton truck axle. Our investigations and tests have shown us the strength and weakness of the various rear drive systems now in use. The logical result has been the development of the one ton axle announced herein. We believe it represents the most serviceable compromise between the conflicting demands of durability, efficiency, quietness, simplicity, neatness and cost.



RUSSEL MOTOR AXLE COMPANY
North Detroit
• Michigan •

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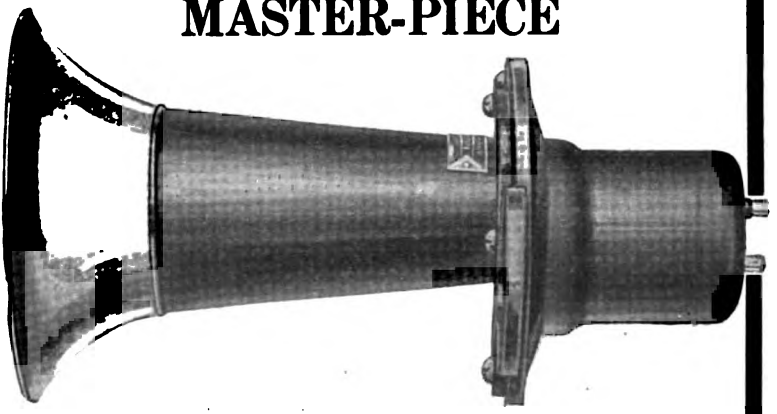
SPARTON

THE WARNING SIGNAL MASTER-PIECE



Mr. Engineer:

SPARTON motor driven warning signals have made it possible to equip your car with the best warning signal manufactured at the price you used to pay for an ordinary **"buzzer"** horn.

We are willing to furnish sample SPARTONS free of charge to be put on break-down tests against any other motor driven signal on the market.

We are at your service.

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Jackson, Mich., U. S. A.

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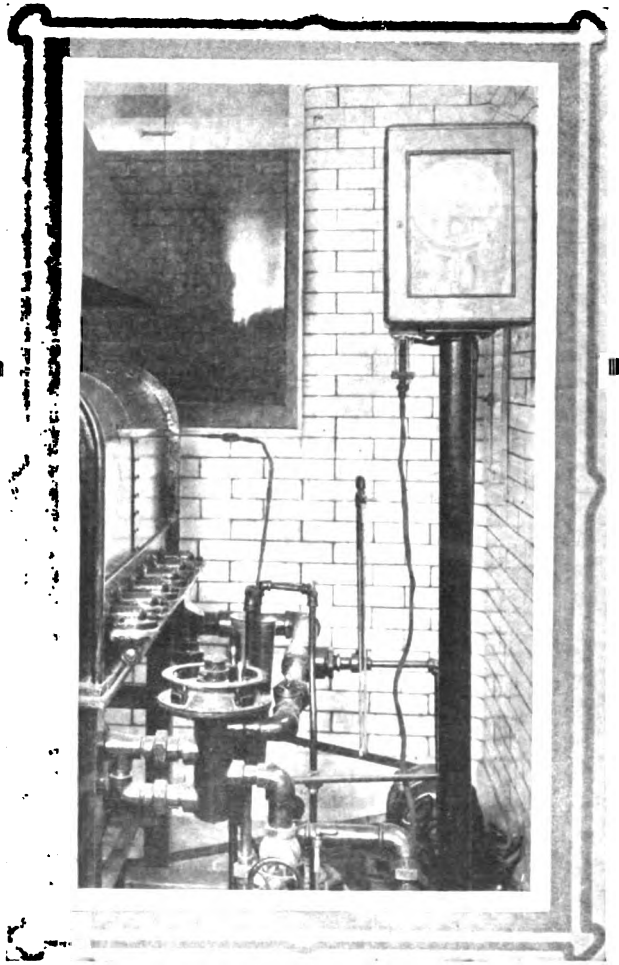

Oil furnace in the laboratory of the Perfection Spring Company, showing automatic means of heat control

MISTAKES ONLY WASTE MONEY

OUR LABORATORY ELIMINATES MISTAKES

The Perfection Spring Company
Cleveland, Ohio

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VOL·VII NO·3

S·A·E BULLETIN

DEC 1914

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ANNUAL MEETING PROGRAM

ABSTRACTS OF PAPERS

STANDARDS COMMITTEE DISCUSSION

BULB NOMENCLATURE

SIDE-OUTLET CARBURETER FLANGES

COPPER PIN STANDARDIZATION

LARGE HEX SPARK PLUG

STANDARD TIRE SIZES

ROLLER BEARING SIZES

BELL HOUSING DIMENSIONS

SOCIETY OF AUTOMOBILE ENGINEERS
1790 BROADWAY, NEW YORK

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SAE BULLETIN

VOL. VII DECEMBER, 1914 No. 3

Published by the Society of Automobile Engineers
1790 Broadway, New York
HENRY M. LELAND, President. COKER F. CLARKSON, Secretary.
HERMANN F. CUNTZ, Treasurer.

Issued monthly, 50 cents a number, $5.00 a year; to members 25 cents a number, $2.50 a year. Entered as second-class matter, August 27, 1914, at the post office at New York, New York, under the Act of August 24, 1912.

ANNUAL MEETING

New York, Tuesday, Wednesday and Thursday, January 5, 6, 7, 1915

PROGRAM

Tuesday, January 5

9 a m. Meeting of the Standards Committee,* at the rooms of the Society, 1790 Broadway.

8 p. m. Meeting of the Governing Committees of the Sections, at the rooms of the Society, 1790 Broadway.

8 p. m. Meeting of the Council, at the rooms of the Society, 1790 Broadway.

*All members are welcome at this meeting

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Wednesday, January 6, 10 A. M. SHARP

In the Auditorium, Engineering Societies Building,
(29 West Thirty-ninth Street)

BUSINESS SESSION

President's Address.

Treasurer's Report.

Report of Tellers of Election of Officers.

Report of Membership Committee.

New Business.

Report of Ball and Roller Bearings Division.—F. G. Hughes, Acting Chairman.

Report of Carbureter Fittings Division.—J. J. Aull, Acting Chairman.

Wednesday, January 6, 1 P. M.

In the Auditorium, Engineering Societies Building,
(29 West Thirty-ninth Street)

PROFESSIONAL SESSION

Automobile Bodies.—H. Jay Hayes.

Report of Standards Exchange Division.—K. W. Zimmerschied, Chairman.

Report of Commercial Car Wheels Division.—Wm. P. Kennedy, Chairman.

Report of Electric Vehicle Division.—A. J. Slade, Chairman.

INFORMAL DINNER, AT 6.30 P. M.

At Bustanobys
(110 West Thirty-ninth Street)

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Wednesday, January 6, 8 P. M.

In the Auditorium, Engineering Societies Building,

(29 West Thirty-ninth Street)

Pros and Cons of Tire Inflation.—C. B. Whittelsey.

Report of Pleasure Car Wheels Division.—Henry Souther, Chairman.

Wood Wheels versus Wire Wheels.—R. B. Mudge.

Wire Wheels versus Wood Wheels.—Geo. W. Houk.

Report of Lock Washer Division.—C. E. Davis, Acting Chairman.

Report of Miscellaneous Division.—J. G. Utz, Chairman

Thursday, January 7, 10 A. M. Sharp

In the Auditorium, Engineering Societies Building,

(29 West Thirty-ninth Street)

PROFESSIONAL SESSION

Report of Electrical Equipment Division.—A. L. Riker, Chairman.

Internal Combustion Locomotives.—A. H. Ehle.

An Eight-Cylinder Motor.—H. G. Chatain.

Report of Research Division.—David L. Gallup, Chairman.

Universal Joint Efficiency.—C. W. Spicer.

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Thursday, January 7, 1 P. M.

In the Auditorium, Engineering Societies Building,
(29 West Thirty-ninth Street)

PROFESSIONAL SESSION

Malleable Iron Castings.—Dr. Richard Moldenke.

Report of Frame Sections Division.—J. G. Perrin, Chairman.

Report of Iron and Steel Division.—Henry Souther, Chairman.

Nomenclature of Car Parts.

Allowances for Piston Fits.—E. W. Weaver.

Manufacture of Worm Gearing by a New Process.—C. T. Myers.

Discussion of Time and Place of 1915 Summer Meeting.

INFORMAL DINNER AT 6.30 P. M.

At Bustanobys
(110 West 39th Street)

Thursday, January 7, 8 P. M.

In the Auditorium, Engineering Societies Building,
(29 West Thirty-ninth Street)

PROFESSIONAL SESSION

Automobile Engineering Curricula.—W. T. Fishleigh.

Motor Car Testing.—A. B. Browne and E. H. Lockwood.

Automobile Warning Signals.—Alden L. McMurtry.

Report of Springs Division.—C. W. McKinley, Chairman.

Cantilever Springs.—J. G. Utz.

The European Situation as Affecting America.—Address by A. Ludlow Clayden.

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Information for Attending Members

THE REGISTRATION BUREAU will open from 9 a. m. to 9 p. m. Wednesday and Thursday, on the second floor of the Engineering Societies Building. To avoid confusion and to aid the Meetings Committee, all who attend are requested to register promptly. This applies to members and guests, including ladies. Upon registration, badges, programs and papers will be supplied.

SESSIONS

Sessions of the Standards Committee and the Governing Committee of the Sections, and the Society will be held on Tuesday at the rooms of the Society, 1790 Broadway.

Business and Professional Sessions of the Society will be held in the Auditorium of the Engineering Societies Building, 29 West 39th Street, on Wednesday and Thursday morning, afternoon and evening.

DINNERS

Owing to the unusual demand for tickets for the informal dinners to be held on Wednesday and Thursday evenings at half-past six, the dinners will be held at BUSTANOBYS, 110 West 39th Street, instead of at the Engineers' Club, which has not sufficient accommodations.

Dinner tickets, $1 each, can be obtained at the Registration Bureau before five o'clock on Wednesday and Thursday.

MEETINGS COMMITTEE

JOSEPH A. ANGLADA, *Chairman.*
J. G. PERRIN,
E. T. BIRDSALL,
JOHN G. UTZ,
FERDINAND JEHLE.

Local Committee.
ROBERT MCALLISTER LLOYD,
ALDEN L. MCMURTRY.

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PROGRAM OF STANDARDS COMMITTEE MEETING

REPORTS

Electrical Equipment Division

Fittings for Single-wire Systems. Dimensions of Bulb Bases. Sockets and Connector Plugs. Lamp Bracket Dimensions. Junction Boxes. Definition of Head-light Glare.

Iron and Steel Division

Physical Properties of Steels.

Frame Sections Division

Fourth Report.

Lock Washer Division

On Specification of Lock Washer Material.

Carbureter Fittings Division

Method of Bolting of Flanges of Side-outlet Carbureters. Extension of S. A. E. Flared Tube Unions to 5/8" and 1/4" Sizes. Tolerance for Union Nut Bore.

Miscellaneous Division

Air Pump Dimensions. Rod and Yoke End Pins. Extension of Thread Standard Beyond 1½" Diameter. Cotter Pin Standardization. Width of Flat Belts for Motor Fans. Hose Clamp Sizes.

Ball and Roller Bearings Division

Stock Sizes of Taper Roller Bearings. Thrust Bearing Sizes.

Research Division

Vehicle Taxation Formula.

Electric Vehicle Division

Motor Characteristics and Voltages. Standardization of Name-Plates. Insulation, etc., of Controllers. Number of Cells in Standard Battery Equipment. Wiring Sizes. Insulation. Charging Receptacles. Fuses. Polarity of Battery Terminals. Lamps. Efficiency Tests of Solid Rubber Tires.

Standards Exchange Division

Bell Housings. Motor Support Dimensions. Piston Ring Groove Dimensions.

Springs Division

Fourth Report.

Progress Report on Nomenclature of Motor Car Parts.

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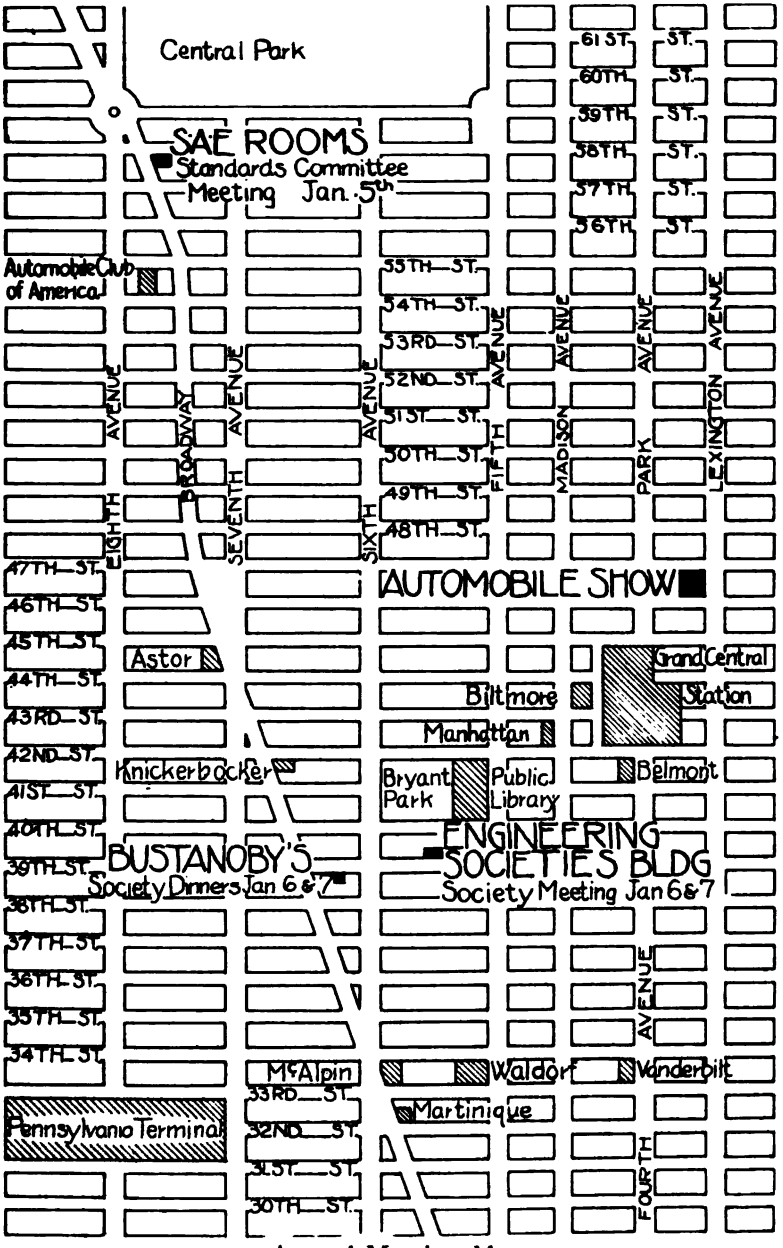

Annual Meeting Map
Where and When

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ABSTRACTS OF ANNUAL MEETING PAPERS*

AUTOMOBILE BODIES*

By H. Jay Hayes

An all-metal body on a steam runabout exhibited at the Washington Park Automobile Show in Chicago in 1899, is described as consisting of a frame supporting the car mechanism and sheet steel panels finished with enamel baked on at a high temperature. This body had been stored in the basement of a shop for twelve years and when examined after this time was found to be in an especially good condition, indicating that if metal is properly treated before painting it will retain its finish for a very long period. It is stated, however, that sheet steel rusts more quickly now than formerly because of the increase of the carbon and manganese contained therein, to obtain a smooth surface for finishing.

Metal bodies were more expensive to build than wood bodies when produced in the small quantities used about 1900. Later, when composite bodies with wood frame-work covered with sheet aluminum or steel were developed, the aluminum type predominated in high-priced cars. Composite bodies are superior to wood bodies due to the scarcity of suitable wood and the tendency of the wood to check or split.

Sheet metal bodies do not require one third the amount of paint to obtain a smooth finish. Some body manufacturers enamel the sheet metal before applying it to the frame. In this case the enamel is baked on at a high temperature. Sheet steels are made especially for the automobile body industry from ingredients selected with great care so as to produce a material which is ductile, of high strength and of great smoothness. The carbon content should not exceed .10 per cent., to provide ductility, and the manganese content must not exceed .40 per cent., to prevent rapid deterioration. The steel sheets are subjected to very accurate heat treatment to establish uniform temper and to relieve any internal strain that may have developed during the course of manufacture.

Five years ago a full-pickled, cold-rolled sheet answered the purposes of body manufacturers. Body, fender, and radiator sheets are dissimiliar in chemical composition and in resulting qualities. Steel used today for pressing or stamping must be soft enough to draw

* Copies of twelve of the papers, the abstracts of which are marked *, were mailed the members recently. Copies of other papers will be distributed at the Society meeting.

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without cracking or straining the metal excessively. Usually the tonneau and shroud or cowl are each made of three pieces joined by acetylene or spot welding and soldered so as to make a smooth joint. Unless this work is carefully done the joint will open in service or the paint may come off in places due to the metal not having been perfectly cleaned.

The backs of seats and cowls are also made in one piece. When this construction is used the wood frame-work can be lighter, due to the reduction in weight of metal supported and the increased rigidity. This construction is also less expensive to finish.

Sheet steel of 18, 20 and 22 gages are usually employed, and before painting the metal must be thoroughly cleaned and sand-blasted to eradicate all irregularities.

Metal garnish rails are used in place of wooden ones and in most cases the sheet forming the door panel extends over the door-opening, eliminating the need of molding and overcoming the former difficulty of paint cracking around the molding.

White ash or maple which has been dried in the air for three to six months and then kiln-dried for six to ten days is generally used for frame work. Metal is gradually replacing wood in automobile bodies as in railroad car construction, some of the best automobile manufacturers using all-metal bodies. In a short time the majority of medium-priced cars will have all-metal bodies with a durable finish produced by enamel baked on at high temperature.

PROS AND CONS OF TIRE INFLATION*

By C. B. Whittelsey

The paper brings out the importance of using the proper size tire for supporting a given car and using the correct air pressure in the tire. Some of the cars today are supplied with tires that are not large enough. This condition brought about the production of the oversize tire. The writer does not concur in the statement that an oversize tire properly inflated will not last longer than a regular size tire pumped up to its regular inflation pressure.

A table giving recommended pressure for different size tires and one giving the loads which they can carry when serving on rear or front wheels, is included in the paper.

WOOD WHEELS VS. WIRE WHEELS*

By R. B. Mudge

This paper attributes the origin of the wire wheel to the necessity of having something that would give better service than the wood

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wheel which was manufactured abroad. The wood available abroad was inferior in quality and not suited to the purpose. Treating the wood and assembling to give the proper results were not understood abroad as in this country. Road conditions in this country are entirely different from those under which the wire wheel was tried out abroad.

As regards tire life, the paper states that many unqualified assertions have been made. Comparisons between wood wheels and wire wheels designed for the same car and equipped with the same type of rim in each case, have demonstrated there is little or no difference in weight between the two. It is stated that the wood wheel is more resilient than the wire wheel. In the wire wheel the load is taken by the upper half of the wheel, the lower half offering no resistance to the rim flattening except the stiffness of the rim itself.

Reference is made to tests conducted at the University of Michigan, in which the wheels tested, for the same car, were mounted on the same hubs, both being equipped with clincher rims. In these tests wood wheels showed up more favorably than wire wheels. Two curves show the result of these tests graphically. Another test of wire and wood wheels completely assembled, with the axles clamped securely, is referred to. The test made by the Automobile Club of America on Pennsylvania "vacuum cup" tires used on wood and wire wheels is also mentioned.

In conclusion, a table showing the percentage of wood, wire and steel wheels manufactured in different countries, is given.

WIRE WHEELS VS. WOOD WHEELS*

By George W. Houk

This paper treats in detail with the result of comparative tests made of wood and wire wheels. The wheels were of the same size and had rims of similar types. In the tests several methods of applying the load were used. In the first series the hub was held stationary and the load applied at the rim; in the second, the rim was supported and the load applied at the hub; in the third, a vertical load was applied to the hub and the rim suported by a six-inch arc of contact.

All these forms of tests are illustrated by figures. The wire wheels showed less deflection than the wood wheels and less permanent set in all cases. As regards relative tire wear on wood and wire wheels, no actual test results are given, but it is stated that three years' contact with consumers who have tried both types of wheel justifies a claim of a 30 per cent. gain in tire service in favor of wire wheels.

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INTERNAL COMBUSTION LOCOMOTIVES*

By A. H. Ehle

Aside from the convenience and serviceability of gasoline locomotives, more general introduction and use of these machines depend upon consideration of initial cost and fuel-operating expense as compared with these items in other available kinds of locomotives. It is suggested that the solution of the problems of large internal combustion locomotives is likely to include new fuels or more efficient methods of using existing fuels.

The specifications of 3½-, 5-, 7- and 9-ton internal combustion locomotives made by the Baldwin Locomotive Works are given. A new 18-ton standard gage type of machine fitted with three speeds in either direction is illustrated, and a table of the drawbar pulls with each speed, together with general dimensions of the locomotive, is given.

The general construction of the four sizes of narrow-gage machines, having two speeds in either direction, is outlined under the headings: motor, transmission and drive, friction clutch, frame, wheels, axles, etc., side-rods, brakes, sanding device, radiator, hauling capacity. Under the heading "Prospect of Broad Developments," the limitations of the present type internal combustion, gas-electric and compressed air locomotives are referred to briefly. It is suggested that work along other lines than those that have been followed in these machines may result in substantial improvement. For instance, the possibility of locomotives employing compressed air which is heated by the jacket water and exhaust gases to increase the efficiency of the air motor, is suggested. Another suggestion is to eliminate the transmission by providing a mechanism to produce exploded charges which would be stored in a thermally insulated reservoir and used as required in compressed air cylinders to drive the locomotive.

AN EIGHT-CYLINDER ENGINE*

By Henri G. Chatain

The paper describes an eight-cylinder four-cycle gasoline engine developed for use in a railway motor car of fifty passengers capacity, with baggage compartment, etc., and capable of attaining a maximum speed of fifty miles per hour on level track.

The first design was a V type 90-degree engine, 7½" x 8", 550 r. p. m. This was operated on a western road until destroyed by fire recently. The second engine was of the same type, 8" x 8", 550 r. p. m. A car equipped with this engine was run 50,000 miles in one year on various roads and showed the following defects: exhaust valves unduly distorted and burnt, requiring frequent regrinding; camshaft

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and valves extremely inaccessible; cylinders could not be made strong enough commercially; excessive vibration due to inability to overcome the horizontal component of the reciprocating forces; engine too wide.

The third engine designed to overcome these defects was equipped with auxiliary exhaust valves, timed to be entirely free of their seats when the piston passes the port opening. These valves require attention only about once a year. The exhaust valves in the head need to be ground every 50,000 miles. The major portion of the exhaust gases goes through the lower ports and valves. Another change in this motor was the re-location of the camshaft to overcome inaccessibility and providing for external location and an oil bath. One cam actuates the auxiliary exhaust valve, and another the intake and exhaust valves in the head.

L-head cylinder castings, unless made very heavy are said to crack. The construction adopted was a barrel and a head with valves contained therein, held down to the base by long studs. The arrangements of two valves actuated from one cam is satisfactory at speeds not higher than 600 r. p. m. A 45° angle between the rows of cylinders was decided upon to decrease the horizontal component of the reciprocating forces, as well as to decrease the overall width. The connecting-rods are mounted side by side on each crank for mechanical simplicity. The piston pins are fast in the rods, bearing in the piston. No bushings are used.

A double carbureter, consisting of a small instrument for running at low speed and a larger instrument which automatically cuts in when the throttle is opened further, is used. Both carbureters are in one unit and hot-air jacketed. The firing order is such that the gas travels from inside outward between each pair of cylinders. The 45° type of engine does not permit of distributing the gas equally to both sides of the engine, due to the inertia of the flowing gas. The total weight of the engine is 9,000 pounds; with generator 13,000 pounds. The lubrication system is of the forced-feed type.

The electric drive which is used with the railway motor car in question, is from the direct-connected generator to two or more electric motors geared to the wheels of the car. The current from the generator is conducted to the motors through a controller whose function is to connect the motors in series for starting and subsequently in parallel for running at speed and also to control the voltage of the generator by varying its field strength. It is stated that at no time is resistance connected in series with the motors and that there are therefore no rheostat losses other than the negligible losses in the field rheostat. The control is obtained by varying the generator voltage to suit the voltage requirements of the motors at all times, with the engine speed constant.

With a 46-ton car on a level track and a constant generator output of 135 kw., full series position is reached in about seven seconds, full parallel position in 39 seconds, and free running speed in 232 seconds.

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UNIVERSAL JOINT EFFICIENCY*

By C. W. Spicer

The paper is based upon a paper presented before the American Society of Mechanical Engineers by Professor P. F. Walker, dean of the mechanical engineering department of the University of Kansas, as the result of a series of experiments on universal joints.

The paper is called to the attention of the Society for emphasis; to develop some of the data into additional curves; and to place the information in the records of the Society.

When joints are properly designed and applied the power losses are negligible. To secure the highest efficiency in two-joint construction the yokes on the two ends of the intermediate shaft should lie in the same plane. This construction is said to be superior to a single joint in securing minimum vibration. Both joints should operate at approximately equal angles all the time. A construction which will accomplish this is illustrated.

The efficiency is practically constant above about 10 per cent. of full load; between 10 and 100 per cent. of full load, the efficiency is above 99 per cent. for all angles less than 7 degrees.

TABLE 1. *Losses in a Set of Two Universal Joints No.* 1. 800 *R.P.M.*

	Angle of Deflection, Degrees (Each Joint)	Load Transmitted by Joints, Watts	Total Losses, Watts	Net Loss, Watts	% Loss	% Effic.
Forks in same plane.	0	7444	3820	00	.00	100.
	3	7450	3835	15	.2	99.8
	6	7490	3880	60	.8	99.2
	9	7460	3930	110	1.475	98.525
	12	7420	4000	180	2.43	97.57
Forks at 90 degrees.....	0	7480	3835	00	0.0	100.
	3	7530	3895	60	.8	99.2
	6	7430	4000	165	2.22	97.78
	9	7370	4130	295	4.0	96.0
	12	7390	4250	415	5.6	94.4

The column "total losses" refers to the total electrical and mechanical losses of the entire testing outfit. The watts lost when running at an angle, less the watts lost when running straight, is the loss chargeable to the joint.

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MALLEABLE IRON CASTINGS FOR THE AUTOMOBILE INDUSTRY*

By Dr. Richard Moldenke

The expansion of the steel casting industry in recent years with resulting improved manufacturing facilities has taken away from the gray iron and malleable casting plants much work to which they were entitled. In self-defence the malleable founder reached out for new lines, among which is included the automobile work.

The automobile manufacturer does not get the highest quality of malleable castings possible to obtain, as his requirements do not harmonize with the best qualities of malleable castings. The status of malleable castings is that between gray iron and steel castings. They are stronger than gray iron, and can be bent and twisted to some extent, and have as their most valuable characteristic the ability to withstand repeated shocks. Malleable castings are superior to steel castings in this respect, although having less tensile strength than steel castings.

White iron castings, because of their ability to withstand very high annealing temperatures for long periods, must be used. Gray iron or a mottled iron, which is white iron beginning to shade into gray, cannot be used. Iron containing between .45 and .75 silicon is best adapted to the usual run of malleable castings; but thin castings can be made from iron containing 1.25 silicon. For railway castings .65 silicon gives most satisfactory results, with minimum cost. Where cost is secondary, .55 silicon iron is superior.

The annealing process or heat treatment given the white iron castings to convert them to malleable iron, consists of raising the temperature of the containers, with the castings packed in oxide of iron, to 1315° F., and maintaining it at this point for at least 60 hours; and then permitting the castings to cool as slowly as convenient.

Malleable castings used for automobile purposes should be made to standardized specifications by founders who specialize in this line of work. It is suggested that an arrangement by all of the automobile manufacturers with selected foundries specializing in automobile work, would result in more satisfactory malleable castings, and involve no injustice to the other foundries which would specialize in other grades of work.

It is not advisable to endeavor to make malleable castings with the maximum of strength possible, but rather to have the castings possess the best bending qualities and resistance to shock.

ALLOWANCES FOR PISTON FITS*

By E. W. Weaver

This paper deals with the allowable piston clearances for water-cooled motors. The method of interchangeable production is dis-

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cussed. Instead of the ordinary rule of making the piston .001 small for each inch diameter of the cylinder bore, the following rule is recommended: Allow from .002 to .0025 for each inch of diameter above 2 inches. This is shown graphically in a chart.

A point particularly brought out in the paper is that the drawings should show exactly the allowable limits to which the shop must work. These limits are to be such that any piston will work in any cylinder. For this a good inspection system is necessary.

MANUFACTURE OF WORM GEARING BY A NEW PROCESS

By Cornelius T. Myers

The paper treats with a particular process of manufacture and not the general subject of worm gearing. The straight type and "hour-glass" type of worm gearing are described, together with the difficulties in the way of assembling and adjusting them. It is stated that the straight type, requiring alignment in only two planes, permitting of more accurate manufacture, etc., is superior to the "hour-glass" type.

The manufacture of a cutter for producing correct worms is outlined in detail and illustrated by drawings and photographs. After milling the worm is carbonized and hardened and ground on a machine which is described. After grinding, the threads are polished and burnished to remove metal or grinding dust. The paper goes into the reasons for the necessity of grinding worms.

The reasons for accuracy in the manufacture of worm gears are specified and the process of manufacture is taken up in detail. Description and illustration of measuring instruments for determining the accuracy of the finished product are given. The resultant accuracy in manufacture is stated, with accompanying efficiency curves and a brief description of the manner of testing.

The application of worm gearing to rear axles for trucks, pleasure cars and tractors is discussed to some extent.

AUTOMOBILE ENGINEERING CURRICULA*

By W. T. Fishleigh

The increasing importance of the automobile industry and the increasing demand for technically trained men in the industry are given as the reasons for the University of Michigan offering five courses in specialized automobile work. These courses comprise the following subjects:

1. Motor, general, the Otto cycle, valves and valve-timing, ignition systems, oiling systems, cooling, carbureters, rating.
2. Clutch.

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3. Transmission and drive-shaft.
4. Rear axle and differential.
5. Front axle and steering mechanism.
6. Brakes and springs.
7. Motor and chassis testing.
8. Car operation and control.
9. Current models.

The laboratory equipment is used for demonstrations and explanations and regular tests made by the students, and for special research work by advance students and the faculty, as well as for development work and special tests conducted for manufacturers, inventors and the public.

The laboratory equipment comprises the following:

Chassis—Studebaker complete cut-out show chassis. Working model friction-drive chassis.

Motors—Hudson Six 54, Franklin Six Thirty, Reo the Fifth, Ford Model T, Krit, Franklin 1908.

Transmissions—Covert selective-type transmission, Timken truck transmission, Ford planetary transmission, working model friction-drive transmission, Franklin selective type.

Clutches—Reo multiple disk, Franklin multiple disk, Ford, Studebaker cone clutch.

Axles and Drive—Timken front and rear pleasure car axles, Timken front and rear truck axles, with transmission and jackshaft. Weston-Mott pleasure car rear axle, Grant Lees bevel-type differential, spur-gear differential unit, two Spicer double universal joint drive-shafts.

Carbureters—Cut section: Schebler, Marvel, Zenith, Rayfield, Kingston. Working carbureters: Stromberg, Zenith, Marvel, Holley, Kingston, Rayfield, Carter, Chambray, Schebler.

Ignition—Complete Bosch high-tension dual system, Bosch high-tension magneto, complete Eisemann high-tension dual system, Eisemann high-tension automatic-spark-advance magneto, Simms high-tension magneto, Delco ignition, starting and lighting system, storage batteries, dry cell sets, vibrator coil sets.

General—In addition, the laboratory is equipped with Prony brakes, water brakes, fuel measuring devices, special cooling water regulating system, pyrometers, manograph set, exhaust gas analysis apparatus, compression gages, and a Diehl dynamometer.

Two specialized automobile laboratory testing courses are offered, comprising the following schedule of tests:

1. Automobile motor construction. Motor is taken down and assembled, with report and sketches on construction and dimensions..
2. Throttle. With constant load and fixed spark, throttle position is varied, with report and curves covering speed and H.P. output variation with throttle opening.

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3. Spark-timing—Horsepower. With constant load and fixed throttle positions, spark is varied, full retard, middle and full advance. Report and curves covering speed and H.P. output variation with spark.

   (Note—Tests 2 and 3 are intentionally very simple, in order to give the uninitiated preliminary experience in operating the automobile motor and in the measurement of brake H.P. output.)

4. Spark-timing—Heating. Keeping H.P. output constant, spark position is varied and B.t.u.'s given to cooling water per hour determined, with report and curves.
5. Compressions. At constant speed and with fixed spark, H.P. output is determined for definite throttle settings and standard compression. Compression of motor is changed, and procedure repeated, with report and curves.
6. Motor wiring, tuning and valve-timing. Student squad is given a motor, with ignition wires off, spark plugs, coil and carbureter out of adjustment, to put in good running condition. Determination of the valve-timing of the motor is included as part of this test.
7. Valve-timing—Horsepower. At specified speeds H.P. output of a motor is determined, with standard valve-timing. Valve-timing is changed by throwing front-end gears out of proper mesh and H.P. again determined, with report and detail discussion of results.
8. Fuel Economy and Motor Efficiency. At specified speeds, and varying H.P. outputs, total fuel consumption per hour is determined, pounds per B.H.P. per hour, and overall efficiency of the motor, with report and curves.
9. R.P.M.—Torque—Horsepower. The standard test for determining torque and maximum H.P. output at different speeds. Standard curves.
10. Manograph. Under specified conditions, manograph cards are taken from motor with a Hospitalier-Carpentier instrument, while B.H.P. output is determined. Report includes calculation of mean effective pressure, indicated H.P., and mechanical efficiency of the motor.
11. Cooling water temperature. Keeping cooling water outlet temperature at stated figure, H.P. output of motor is determined. Test is repeated at several other temperatures with report and curves.
12. Complete motor test. With Diehl dynamometer and auxiliary equipment a complete motor economy and efficiency test is run, with determination of the following: Motor torque, B.H.P. output, total fuel consumption per hour, fuel consumption per B.H.P. per hour, indicated horsepower, fuel consumption per indicated horsepower per hour, friction H.P., mechanical effi-

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ciency, heat loss in cooling water, heat balance of engine, thermal efficiency, overall efficiency, complete report with standard curves.

THE PRACTICAL TESTING OF MOTOR VEHICLES*

By A. B. Browne and E. H. Lockwood

The paper deals with the determination of the actual performance of a car as a whole. In such a determination several uncontrollable variables are introduced, such as road conditions, windage, grades, lack of accurate apparatus applicable to a standard car, and inability to measure fuel consumption on account of vibration. The paper deals with a method of block testing, the results being reproducible on the road. Rolling resistance is determined by readings of a recording dynamometer consisting of a Tabor gas engine indicator, the pull necessary to tow the car along a level floor being measured.

Power measurements are made by running the rear wheels on a set of brake drums connected to a Prony brake with a rope strap. Speed is determined by a Hopkins electric tachometer, checked up by a counter and stop-watch on the operating table. Fuel consumption is measured by weighing, a mercury-contact electric circuit giving warning when the required quantity of fuel is used. To prevent overheating cooling water is added to the radiator, the temperature being usually kept at 160° F.

A formula is developed for determining the rolling resistance, taking the projected area of the car into consideration. Nine runs are made, measurement being taken.

Run 1. At 5 miles per hour, or slowest speed possible, load equal to rolling resistance, level.

Run 2. At 10 miles per hour, load equal to rolling resistance, level.

Run 3. At 10 miles per hour, load maximum at that speed.

Run 4. At 20 miles per hour, level road resistance.

Run 5. At 20 miles per hour, maximum load.

Run 6. At 30 miles per hour, level road resistance.

Run 7. At 30 miles per hour, maximum load.

Run 8. At 40 miles per hour, level road resistance.

Run 9. At 40 miles per hour, maximum load.

From these records the following calculations are made:

Actual speed, miles per hour.

Maximum drawbar pull.

Level road drawbar pull.

Gasoline, reduced to miles per gallon, level road.

Gasoline, reduced to miles per gallon, full load.

Effective drawbar pull.

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Horsepower at rear tires, level road.
Horsepower at rear tires, full load.

These results are plotted on curves shown.

The curves of drawbar pull for level road and full load conditions, as well as fuel consumption for level road or full load conditions, intersect at the maximum speed of the car. Curves, both theoretical and actual, are given for maximum and minimum fuel consumption, pounds effective pull per 100 pounds car-weight and negotiable grade per cent. These curves are taken from the performances of six representative American cars.

In order to be satisfactory to the motor car owner, a car must have a wide speed-range on high gear, quick acceleration, good hill-climbing ability and high fuel economy. Formulas are developed for the determination of acceleration and hill-climbing ability. A maximum speed on level road is identical with full load on the same abscissa. These curves should intersect at the same point where the pounds effective pull curve reaches zero. The various curves are analyzed and the special conditions which they indicate exposed.

The various tests shown on the curves have been checked up under strictly test conditions and under ordinary driving conditions with very close results. A table showing this comparison is given.

The tests show the performance of the car as it is at the moment of testing. The changing of any factor such as tires or carbureter adjustment will change the readings.

The various components entering into motor car construction may be investigated by this method, maintaining all the conditions constant except the one investigated.

Curves showing gasoline consumption under level road and maximum load conditions, as well as pounds effective pull per 100 pounds of car-weight and maximum grade, calculated from Dr. Reidler's observations in his work "The Scientific Determination of the Merits of Automobiles," are given, together with Dr. Reidler's curves. It is stated that the determination of the results shown occupied but a few hours, while Dr. Riedler's curves could be developed only after protracted and painstaking effort.

The paper closes with a protest against the use of horsepower as a unit of motor car rating, and the suggestion that automobiles be rated according to drawbar pull.

AUTOMOBILE WARNING SIGNALS

By Alden L. McMurtry

The construction, application and use of audible warning signals are, as a matter of public safety, deserving of more attention than they have ever received. The history of the automobile warning signal is traced through the many earlier types of instrument. The

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theoretical requirements of the signal itself are analyzed, leading up to a general discussion of the power-operated mechanical diaphragm horn. Upon this type alone, it is asserted as much research has been outlaid as upon any other single feature of automobile construction. Diaphragm action, resonance and the resultant sound waves are examined and compared by means of photographs, showing clearly the importance of scientific developments along this line. Tests of signals should be based, not upon the duration of a single signal, it is suggested, but upon the maximum number of short signals that can be given without adjusting the apparatus. A suitable basis for a uniform code of warning signals is proposed, distinguishing between signals of danger and signals of intention.

CANTILEVER SPRINGS *

By J. G. Utz

Generally speaking the advent of the cantilever spring has been sudden, but this type of spring has been in use in England some ten years. The Lanchester spring is described as not conforming to the technical definition of a cantilever spring. The technical definition of the Lanchester spring includes a combination of links like those of a pantograph, to avoid "shuffling" of the tires when the axle moves in relation to the frame, and also to take torque and drive.

The name "half-elliptic cantilever" is suggested as best describing the springs in question before the public in this country. In the general analysis a comparison with the half-elliptic is made by means of diagrams and mathematical data. Four examples are shown.

Case one is a half-elliptic spring supported at the center and loaded at each eye with A pounds, the resistance at the center being $2A$ pounds. With an assumed deflection of one inch per 100 pounds of load at each eye, the resistance at the center would be 200 pounds, and as a half-elliptic it would be said to carry 200 pounds per inch of deflection.

Case two comprises the same spring used as a half-elliptic cantilever, restrained against vertical movement at one eye and in the center. This spring would have four times the flexibility of case one, and would be said to carry fifty pounds per inch of deflection.

In *case three* the method of loading is the same as in case two, but the load is increased twofold, producing a deflection twice that of case two. To alter this spring to give a deflection of one inch per 200 pounds of load, it would be necessary to make it four times as stiff as in case one. The method of increasing the stiffness, keeping the length standard, is shown mathematically by five trial examples, varying the width of the spring, the number of plates and the ruling thickness of the plates. The increase in weight due to changes of these factors is shown.

Case four.—In practical applications it is indicated that a car

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may be carried on cantilever springs with about two-thirds the pounds per inch needed with half-elliptics.

Comparison is made of cantilevers with three-quarter elliptics and platform types; a tabular comparison of an application of three-quarter-elliptics and cantilevers on a 4,000-pound car is given, showing a saving in weight in favor of cantilevers of 15 per cent., including the weights of scroll-hangers on the three-quarter elliptics. Comparing the bottom halves of the three-quarter-elliptics to cantilevers, a saving of 28.8 per cent. is obtained.

A comparison of the amount of vibration of half-elliptics and cantilevers is made, it being stated that with the cantilever, the inertia imparted to the passenger is only 58.2 per cent. of that imparted by the half-elliptic.

The distortion and consequent fiber stresses in half-elliptic and cantilever springs is treated mathematically, with the conclusion that the extreme fiber stress in the cantilever spring never exceeds 80.5 per cent. of that of comparable half-elliptic springs, and in some cases is as low as 50 per cent., when additional stiffness is supplied in the cantilever by increasing the number of plates or their width. In the recapitulation the points in favor of the cantilever suspension are listed as follows:

First—Decreased weight over three-quarter-elliptic or platform types.

Second—Increased pendulum length, producing slower vibration.

Third—Increased physical comfort due to decreased inertia effect.

Fourth—Increased damping ability.

Fifth—Decreased fiber stress.

Sixth—Increased dynamic life.

The only point discussed not in favor of the cantilever is its increased weight as compared with the half-elliptic.

The various common methods of attaching cantilever springs to the frame and axle are discussed with reference to figures shown, methods of attachment to the rear axle, to transmit drive or torque, being outlined. An example is shown in which both drive and torque can be transmitted, but with excessive angular deflection of the universal joints.

Relative to the shape of cantilever springs, reasons are given for the statement that "the main leaf of the spring should be straight and parallel to the ground under normal load."

The effect of the use of cantilevers on frame design is referred to briefly.

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STANDARDS COMMITTEE MEETING

Held at the Society Rooms, New York, November 17, 18, 19

The meeting was called to order by Chairman Souther.

FELLOE BAND THICKNESS

WILLIAM P. KENNEDY:—At a joint meeting of the Truck Standards Division and the Commercial Car Wheels Division, the following resolutions were passed:

> "Resolved, that an increase in the felloe band thickness from ¼ inch to ⅜ inch for 4-inch single tires, be recommended."
>
> "Resolved, that there be recommended for adoption at a later meeting an increase in felloe band thickness from ⅜ to ½ inch for 6-inch dual tires and over."
>
> "Resolved, that this meeting recommend for consideration of the Commercial Car Wheels Division that the side flanges or clamps for tire attachment be so designed as to have a flat surface for contact with the sides of the wood felloes, to give sufficient bearing surface to avoid crushing the wood felloe."

We would like to have the first resolution accepted by the Standards Committee. From communications we have had from truck manufacturers, users and wheel builders it appears that it is desirable to increase the thickness of the felloe band for the 4-inch single tire. The present recommended practice of the Society specifies a ¼-inch felloe band for 4-inch single tires and under. For 4½-inch tires or over the recommended felloe band thickness is ⅜ inch. It appears that the ¼-inch felloe band is not thick enough to give the draft necessary in wheel construction, and it is therefore considered desirable to extend the ⅜-inch thickness down to the 4-inch tire.

The matter has been given consideration from all angles, with due reference to our desire not to change too quickly any recommendation we have advanced, but it seems this change is desirable. It will cause a slight increase in the weight and cost of the felloe band in the case of the particular wheel employing a 4-inch single tire.

The reason we are merely taking under consideration at the present time the matter referred to in the second resolution, is to allow some time to elapse before we finally act on it, to afford an opportunity to the truck manufacturers and others interested to express their views on the subject; because it seems a more serious change than the one that we are advancing for acceptance at this time. It is increasing the thickness of the felloe band for 6-inch dual tires

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and over, with which a ⅜-inch felloe band is now used, to ½ inch. It is not required necessarily in the construction of the wheel to provide draft but is said to be necessary to preserve the structure of the wheel under the severity of duty on heavy trucks. In other words, large wheels, particularly in cases where the spoke is not in the center of the felloe—and that is the case in nearly every instance—have to go back occasionally to the wheel-maker for rebuilding or modification, and the evidence thus placed in the hands of the wheel-maker is that such wheels are not strong enough to stand up under the working strain with a ⅜-inch felloe band. A ½-inch felloe band is therefore more desirable. This ½-inch felloe band is going to increase the weight and price seriously, decreasing the small margin of price now existing between the heavy wood wheel and the metal wheel.

The matter referred to in the last resolution is a very minor one and does not require any action on the part of the Standards Committee.

CHAIRMAN SOUTHER:—Mr. Kennedy, referring to the first resolution, I presume that the exterior diameter of the felloe band would remain the same, with the increased thickness.

WILLIAM P. KENNEDY:—Yes.

CHAIRMAN SOUTHER:—We would be very glad to have the subject discussed. It is one of the evolutions that are bound to take place as the art gets older. If this body does not follow the developments, it will be a good deal more at fault than if it sticks to some standard that is nearly right. Are there any objections? Are you ready for the question? Those in favor signify by saying "Aye." Opposed, "No." It is a vote.

CHAIRMAN SOUTHER:—Are there any remarks on the second resolution?

R. MCA. LLOYD:—I would like to ask whether anyone has made any experiments which prove that a ½-inch thick felloe band will stand up any better than ⅜, with offset spokes; whether the wheels will not go to pieces just the same?

WILLIAM P. KENNEDY:—No experiments have been made. It is the only increase that we could make in the felloe band, due to the location of the bolt-holes for side-flange attachment of tires. As a matter of fact, with the ½-inch thick band the outer edge of the bolt-holes would be in contact with the inside of the felloe band.

We do not hope that the change would cure the condition altogether. The trouble is not so much with the felloe band as with the off-centered spoke. The opinion of the wheel manufacturers who discussed the matter this morning seemed to be that the thicker band would be a very great improvement and go a long way towards correcting the present difficulties.

H. D. CHURCH:—How many wheel-makers have had a chance to express their views on the subject?

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WILLIAM P. KENNEDY:—A number of them. We circulated a communication through which we secured a registration of the views of the various wheel-makers upon the existing difficulties. We interchanged their original communications and in that way obtained further discussion of the subject, which enabled us to thresh the matter out as well as it could possibly be in advance of the meeting. And in the meeting today we had several of the wheel-makers present

H. D. CHURCH:—Is the consensus of opinion among the wheel-makers in favor of the increase?

WILLIAM P. KENNEDY:—Yes.

H. D. CHURCH:—Not only those wheel-makers present this morning, but the others with whom you corresponded before this meeting?

WILLIAM P. KENNEDY:—They all seemed to indicate in the correspondence that some heavier felloe band is necessary on the large wheels.

H. D. CHURCH:—Do they recommend an increase up to ½-inch?

WILLIAM P. KENNEDY:—Not all of them, because the subject was not discussed down to that detail. We are limited, as I said, by the spacing of the bolt-hole circle. There is at the present time only ⅛" of material between the outer edge of the bolt-hole and the inside of the felloe band. We cannot very well change the bolt-hole circle without having the tire-attaching flanges in the hands of the tire companies and the other devices that are used changed. It would be a very serious change to alter the bolt-hole circle.

H. D. CHURCH:—I rather feel the way Mr. Lloyd does about it, that we do not know whether the change is going to be of enough benefit to warrant making it. It is questionable.

WILLIAM P. KENNEDY:—That is one of the considerations we had in mind in deferring final action on the subject. We want the broadest possible exchange of views so that when we finally recommend a change, if we do, it will be warranted.

RUSSELL HOOPES:—I think it would be well to have expressions as to the tendency to place the spokes on dual rear wheels more centrally than now; that is, to do away with that part of the overhang. Is there any inclination in redesigning trucks to place the spoke more centrally, or is it considered good engineering to place them as at present, with a great amount of overhang?

CHAIRMAN SOUTHER:—That is a very interesting phase to bring up at this time. There is no question but that with a spoke the full width of the felloe band the wheel would stand up.

E. R. WHITNEY:—I feel that the spoke should be just as nearly central as it is possible to place it. In the committee meeting I dissented from the tentative resolution under discussion. I think, however, that I was the only one who was against the motion. I am not sure that the increased thickness would not be a good thing, but I do not feel sure that it is going to cure the trouble. I think that there is enough material in a band 12 inches wide and ⅝ thick to

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exert sufficient pressure to properly seat the spokes, and so forth. I did vote in favor of increasing the thickness of the 4-inch band from ¼" to ⅜". It is very evident that that size is relatively much weaker than the band on the wider wheel. I think the whole trouble is due to the offset of the spokes and the fact that a great many wheels that were not properly built have been turned out, either improper or inadequate machinery for pressing up the very heavy green timber, etc., having been used.

CHAIRMAN SOUTHER:—Is there anything from your standpoint, Mr. Whitney, that prevents the use of a spoke that is central, or one covering a greater portion of the width of the felloe?

E. R. WHITNEY:—All of our spokes are central. The widest of our felloes is 10", for 5-inch dual tires. I think the difficulty comes in with the chain-driven truck. It is rather difficult to make an absolutely central spoke in that case.

R. MCA. LLOYD:—I agree with Mr. Kennedy's policy of deferring any action on this matter until we shall have had some more information. Personally I believe that the heavier felloe band is not going to cure the trouble, because I think the wheels deteriorate in the seat of the spoke, and the spokes themselves, due to the greater leverage strains when the bearing is on the outside of the overhang. I never saw any trouble with the felloes. I do not see why the heavier band should strengthen the wheel and I believe that somebody ought to get some data before we take any action. The proposed change would mean an increased cost and weight of wheel. I know it is very difficult in many cases to put the spoke in the center, owing to the offset sprocket drum and other details.

The wheelmakers might put out a few wheels with heavier bands and let somebody try them. I cannot see any theoretical reason why they should support the spoke any better than the band we have now.

H. D. CHURCH:—I would like to ask a question. My experience with wheels has been largely with the offset-spoke type, that is, on rear wheels. Our front wheels have the spokes central; the rears are all offset. I have never seen a wheel failure which did not show that the spokes loosened up in the felloe first.

I would like to hear from some of the wheel-makers and find out if it is not possible that wheel failure is due to the fact that there is not a large enough shoulder on the spoke where it goes into the felloe. I would like to know if that is the trouble, or if the trouble is in the thickness of the band.

T. V. BUCKWALTER:—I am neither a wheel-maker nor truck-maker in the commercial sense, but I think I can shed some light on the point raised by Mr. Church in regard to the small cross-section where the spoke abuts on the felloe, and the fact that the spoke abuts with the end-grain against the cross-grain of the felloe. From my own experience in other lines of work the end-grain will stand considerably more than the cross-grain, probably ten times as much; and the failure in

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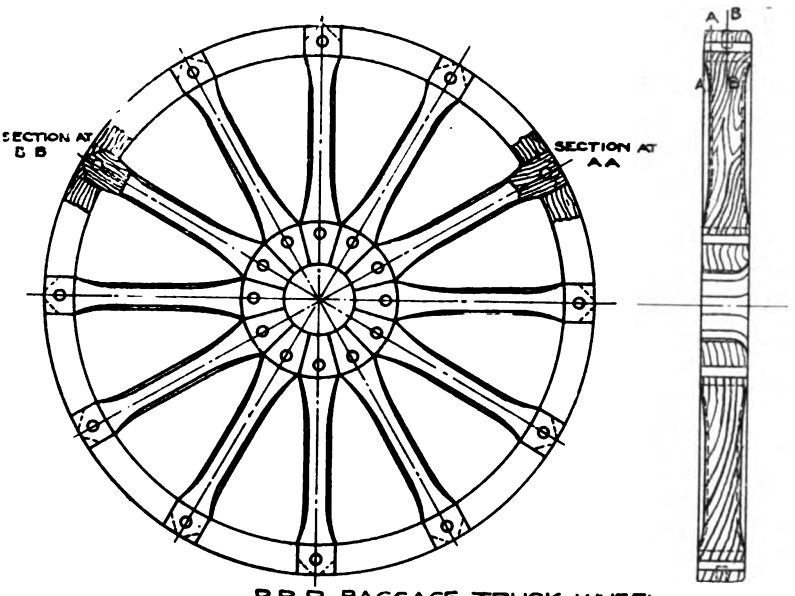

P.R.R BAGGAGE TRUCK WHEEL

the wheels may therefore be due to the fact that the cross-grain of the felloe gives way to the superior bearing properties of the end-grain of the spokes, and the wheel therefore becomes loose, regardless of how the band may be put on the felloe. The band may be applied tightly enough on the felloe, so that the felloe resists the band entirely, and yet the spokes can sink into the cross-grain of the felloe and make a loose wheel. That was our experience on our earlier baggage trucks, which, while they are small trucks, are sometimes greatly overloaded; and that was one of the first things we investigated. Our cure for the trouble was effected by a design whereby the full cross-section of the spokes engages directly upon the metal rims, eliminating the felloe entirely. The end-grain of the spokes, which for a 3½-inch tire is made 2" wide by 1½" long, abuts against the rim, and wood fillers are placed between the spokes to retain the spokes in position. Flanges were formed on the rim, an integral flange on one side and a removable flange on the opposite side to clamp the spokes and wood fillers in position.

Eight hundred of the wheels have been made and as far as I know there has never been a failure from service. They have been overloaded three hundred per cent. and to the best of my information there have been but three wheel failures. One of those resulted from a drop of about thirty-five feet; the other two from a collision with a locomotive. Numbers of the trucks, about three dozen according to

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my recollection, have fallen off the baggage platform to the track, at the Pennsylvania Station in New York, a fall of about four feet. None of the wheels has ever failed due to this fall, although the steering-gears and axles have often failed.

On large-sized trucks for carrying heavy loads, I think this method of making wheels offers a solution of the wheel troubles which may be of value. The difficulty is in the end-grain of the wood sinking into the cross-grain of the felloe, and the solution is to eliminate the felloe and have the end-grain of the wood abut against the metal band.

H. D. CHURCH:—Was the shoulder on the end of the spokes made with a curvature to conform to the inside of the metal band?

T. V. BUCKWALTER:—The shoulder was made with a curvature. It is rather an expensive wheel to make, because we have not discovered any way that the spokes can be made accurately without simply assembling the job on the hub and then turning the outside, with the spokes and the fillers. It makes a remarkably accurate wheel, just as accurate as a metal wheel.

CHAIRMAN SOUTHER:—It has always seemed to me very unfortunate that there should be such a tremendous overhang. I have not been able to comprehend how any wood reinforced by a relatively light band can resist indefinitely the load coming upon the overhang, often the entire load for that wheel. It seems to me it must go little by little, like in a swaging operation, until the overhung part of the felloe becomes distorted in such a way as to finally ruin the wooden parts with which the spokes engage. Is not the idea of the tremendous overhang all wrong fundamentally?

H. D. CHURCH:—Mr. Whitney brought up a point which is perfectly correct, that unless you do make an overhung wheel in the large sizes, it is difficult to design the sprocket properly. There is another difficulty in the rear hub cap, which is the most likely to get into trouble in traffic and turning corners, and which can be protected in an overhung wheel. The engineer has had these two points in mind in designing a wheel, and the wheel-makers seem to think the engineers should go ahead and design the wheels.

CHAIRMAN SOUTHER:—I have not been able to see why some support should not be carried from the hub to the outer edge of the felloe to obviate the effect of the overhang. This seems to be the only way we have, and that is done now in some cases by making a wide spoke at the felloe and a relatively narrow spoke at the hub.

H. D. CHURCH:—The expense is the chief objection to that design.

CORNELIUS T. MYERS:—I would say that the trouble is due largely to the overhang. I doubt whether the heavier felloe band will obviate the trouble. The designer has always been put to very serious compromises in the parts of the rear axle of a chain-driven truck, where allowance for skid-chain clearance between the side chain and the edge of the tire has to be made. That to my mind was very largely the cause of a big offset of the spoke. If the spoke

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could be put out in the middle of the felloe, that would, I think, be a far more preferable way of avoiding the trouble; in fact, you can be practically sure of eliminating trouble if you can get a fair sized spoke in the middle of the wheel. A man without any experience in truck design will look at that big offset with a feeling that it is not quite what it ought to be, and of course it is not right. I think the solution is for the designer to recognize that it is inherently bad design and cut down the overhang on the band. I know it is a very difficult point to meet.

RUSSELL HOOPES:—I do not know whether all of you are familiar with the two types of hubs for horse-drawn vehicle wheels. One is the Warner type, which is a malleable casting with flanges and divisions all cast in one. The other is the Sarven, in which, instead of making the hub divisions in a casting, as in the Warner, the spokes are mitered so as to form a perfect arch.

T. V. BUCKWALTER:—The kind of spoke we use, according to your explanation, is the Sarven patent?

RUSSELL HOOPES:—The Sarven and artillery practice are about the same.

T. V. BUCKWALTER:—The wheel I spoke of is an artillery wheel, at both the hub and the rim. The spokes were made of second growth hickory and the filler of any hardwood available.

RUSSELL HOOPES:—That type of wheel seems rather troublesome to make. We do not feel that the greater part of the wheel trouble is due to the present thickness of felloe band. We feel that the spoke does not have sufficient shoulder underneath the wood felloe, and also that in a great many cases enough care is not taken to see that the end of the spoke tenon that goes through the wood felloe has a bearing on the metal band. If you have the spokes too long, the wood felloe will not be seated on the spoke shoulder; it is a pretty nice point to get right, because before the felloe band is applied the wood felloe is not down on the shoulders of the spokes perfectly; it is pretty hard to get the tenons of exactly the right length.

There is a way in which the spoke shoulder can be increased without increasing wheel cost, up to a certain point. A great many truck wheels appear to have been copied after the old horse-drawn vehicle wheels, as regards the barrel of the spoke, with a very small shoulder; and that certainly is very bad engineering. There is no reason why the spoke shoulder on the felloe end should not be as large as it is possible to get out of a piece that will make the given miter of the spoke on the hub. That can be done without any additional cost. You can also go further, making on offset towards the outside to give increased bearing, but this increases the expense. You are probably all familiar with this type of spoke of which the Peerless is an example. In the Pierce-Arrow construction a metal ferrule is put around the end of the spoke, providing all the bearing there is in the cross-section of the spoke at the felloe; the size of the metal bush is increased to give increased bearing on the wood felloe.

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I am sure that, taking the majority of trucks as they have been built, the bearing of the spoke shoulder on the wood felloe can be doubled without any increased cost at all, by getting all the bearing that it is possible to get out of a given piece that makes the miter. A great many wheels are manufactured with the tenon short, for convenience or for quickness of manufacture; the tenon does not get any bearing. The result is that about half the efficiency is lost, by not letting the spokes bear on the felloe band.

I hope that the truck engineers will take into consideration the amount of overhang and the trouble that it makes the wheel men to support the extra strain on the wood. I think that will help us out as much as anything, and I am doubtful whether the increased thickness of the felloe band will help. It has been said that if the felloe bands were made smaller, below size, we could to a certain extent put them on tighter. That would not be good engineering and we would not have as good practice if the tire people shall continue to require the tolerance they now ask for. They ask for a very close tolerance; that has made it difficult for the wheel-maker. If we had a little more latitude as to the diameter after the felloe band is applied, I think we would not have trouble with the ⅜-inch thick felloe band.

E. R. WHITNEY:—Mr. Hoopes confirms the statement that has been made that there is enough stuff in the band to make a good wheel. It is just a question of utilizing the material somewhere nearer its elastic limit. It has been my experience that if a wheel is made out of dry stock to begin with and pulled up tight as a drum it will never be heard from in service. If, however, it is not pulled up tight or it is made out of green stock, so that after a while it gets loose, it will go to pieces very rapidly.

That brings up another point. Mr. Hoopes says it is difficult to keep within the tolerance and still make the wheel tight. I think that is the crux of the whole thing. What is being suggested here, that is, a thicker band, is going to add to the expense a bit more than would be necessary to machine the wheel after the band is on, probably two or three times as much, to say nothing of the weight. The standard that we now have does not say how the wheel manufacturer is to reach the accuracy demanded. It does not bar him from machining or grinding the wheel. It seems to me it might be well to add a clause recommending machining the band if necessary to reach the required accuracy. Let the wheel-makers put the band on tight the way it should be, and then if it is outside of the tolerance, machine it off.

F. A. WHITTEN:—We had trouble with wood wheels. When we went back to the wheel-makers they attributed it to their bands not being tight enough and found it economical to machine the bands. Since they have been doing that, the wheels have stood up. This refers to wheels of large diameter, heavy wheels. The machining has apparently stopped all the trouble; we do not have any loose wheels

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at all any more; which means, I suppose, that the wheel-makers put the bands on tight and get the diameters by machining afterwards.

RUSSELL HOOPES:—May I ask if the bands were ⅜" thick in the first place and then cut down afterwards?

F. A. WHITTEN:—Yes, but the amount that was taken off was practically nothing. They were turned off in spots only.

RUSSELL HOOPES:—They were ground off rather than turned?

F. A. WHITTEN:—No. I think they were turned. They showed the tool marks. But the amount taken off was practically nothing.

W. H. CONANT:—This seems to be an experience meeting and I would like to tell about a wheel that is made by S. R. Bailey & Co. The elder Mr. Bailey, who is a carriage man, tried in making electric vehicles to break away from all practice that he had been familiar with that did not apply directly to the vehicle he had in mind. He makes a wheel somewhat like Mr. Buckwalter's. The spokes are driven into rectangular receptacles in the hub and the outer end of each spoke is tapered round. On the outer end of the spoke is driven a flanged ferrule, tapered. When the flanges are all driven home, the wheel is put in the lathe, and trued off round. The flanged ferrules are then riveted directly to the clincher or other form of rim to be used. The spoke is made with a slight belly in the center. Mr. Bailey claims that this is the lightest and strongest wheel he has ever made in many years of wheel building experience.

CHAIRMAN SOUTHER:—Is there any trouble with the rivets working loose?

W. H. CONANT:—He has said he has never had any trouble with that since he started.

CHAIRMAN SOUTHER:—With pneumatic tires?

W. H. CONANT:—I think they use both pneumatic and solid.

B. B. BACHMAN:—I have had no experience with the larger size wheels. Several years ago we had trouble with our wheels loosening up. Mr. Hoopes increased the size of the spokes, getting a greater bearing on the felloe, and we have had no trouble since. That was with 34 x 4, 34 x 4½ and 34 x 5 wheels. They run at pretty high speeds and in some instances practically without any rubber on them. We have very little trouble, which I attribute entirely to the way the spoke is put in the felloe.

H. B. COLEMAN:—In connection with the dimensions of spoke at the felloe, one prominent truck manufacturer for instance, has a 2" by 1" spoke. He might have instead of that inch, 2 11/32", making a shoulder 2" x 2 11/32", without any extra cost. Another specification of 3" by 1½", might have been 3" x 2 9/16". In other words, some have just about half the bearing on the felloe they might have, with no additional cost to the wheel builder.

RUSSELL HOOPES:—Some wheel manufacturers have increased the bearing by making the shoulder of the spoke conform to the arc of the wood felloe, thus avoiding crushing the wood felloe to get a perfect bearing.

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CHAIRMAN SOUTHER:—May I ask if the end of the tenon also follows the circumference of the steel felloe band?

RUSSELL HOOPES:—We aim to do that as closely as we can. In assembling a wheel the wood felloe is not absolutely circular, and for that reason not all down on the spoke shoulders. The wood wheel has to be turned off. If the felloe is not down on the shoulders, we counterbore it and try to make it become so.

E. R. WHITNEY:—It seems to me that the troubles that are being brought out here are enough to account for loose wheels, without attributing them to the felloe band.

CHAIRMAN SOUTHER:—We have surely developed several points of view, which is the function of this committee. I am looking for progress all along the line. I hope that there will be the most hearty co-operation between the man who designs and the man who builds. If they do not get together, neither of them does what he can do. I think that co-operation will lead to a world of good, and I hope that it will prevail more and more.

WIRING SYSTEMS

W. H. CONANT:—The Electrical Equipment Division has come to the conclusion that the Society does not care to have it recommend standard practice as to wiring systems of electrical equipment on gasoline automobiles, and has decided to defer any action on that subject until further development shall make it necessary to take it up again or until the Society desires it considered again.

NON-GLARING HEADLIGHTS

It was decided by the Division to appoint a sub-committee to go into the matter of non-glaring head-lights as far as possible by consulting various ordinances, in order that it may present for the Division's consideration something upon which we might act in an intelligent manner. We are very desirous of anticipating drastic legislation, and rather than pulling against the tide trying to present some form of definition for uniform adoption through the various automobile clubs in the various sections of the country.

SINGLE-WIRE FITTINGS

The sub-committee on single-wire-system fittings hopes to have a report ready for the Winter Meeting.

A recommendation received by the Division concerning specifications of fuses in greater refinement than previously recommended by it was referred to this sub-committee.

A suggestion received that uniform curves sheets for electrical apparatus be put into use was considered without definite action.

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BULB NOMENCLATURE

The committee did take a definite step forward in defining certain terms now common in the industry, but which are often confused. I will read the resolution:

> "Upon motion, duly seconded, it was voted that the Division designate by the word 'bulb' the detachable electric light-giving unit comprising the filament and its glass envelope; and designate by the word 'lamp' the fixture for mounting and utilizing the light of the bulb."

The Division hopes that this will help to avoid constant confusion in the matter of calling a lamp a bulb and a bulb a lamp, or a lamp bulb or an incandescent lamp.

BULB-BASES, SOCKETS AND CONNECTOR PLUGS

After some discussion it was voted that a sub-committee be appointed by the chair to further standardize bulb-bases, sockets and connector plugs.

Our Division further considered the matter of trying to standardize head-lamp brackets as well as side- and tail-lamp brackets. It was voted to have the chair appoint a sub-committee on this subject.

JUNCTION BOXES

The Division discussed to some extent the matter of recommending providing in all wiring systems a junction box, together with at least one open connection, to be used whenever electric appliances are to be added to the car after it is sent out from the manufacturer's plant. We took no definite action on that, but wish to report that we favor considering the subject further at an early date.

Glaring Headlights

CHAIRMAN SOUTHER:—Gentlemen, you have heard the report of Mr. Conant, Acting Chairman of the Electrical Equipment Division. Speedy action is essential in the matter of non-glaring headlights. The ordinances of cities and the statutes of the state legislatures are very exacting now and the police seem to take delight in enforcing the regulations. At the same time there is no fair measure at all of what a glaring head-light is. There is a difference in opinion between policemen from one block to another. If we are going to do our greatest good we must act quickly.

V. G. APPLE: This is a pretty hard problem. I am beginning to believe that the solution lies in the use of a searchlight for country driving and a pair of signal- or side-lights that will pass the city ordinances. If you have a head-light that can be called non-glaring you will find it kills the light for country driving when you need more rather than less light.

C. W. MCKINLEY:—In several states there are laws requiring the turning off of head-lights or bright lights upon meeting a machine

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or other vehicle on the road. In that case the brighter lights you have, the worse off you are, because when you turn off the bright light you can hardly see the road, on account of the great difference in illumination of the head- and the side-lights. As regards the lights in cities, I know of several cities in which the laws are so drastic that you could not use electric head- and side-lights if the police should enforce the laws. The ordinances read that it is unlawful to use a light which is intensified by a parabolic mirror or lens. About the only thing a man could do would be to use an ordinary lantern hung on a pole in front of his car.

V. G. APPLE:—I have been driving this summer with a piece of amber glass across the windshield. When I meet an automobile or traction car with a bright light, I look through the colored glass which kills the glare of the light. I think we will have to protect ourselves in this way.

CHAIRMAN SOUTHER:—That does not help the pedestrian or the man driving a wagon.

V. G. APPLE:—Let him wear colored glasses. He can buy them for ten cents.

CHAIRMAN SOUTHER:—Three types of solution were specified this morning in committee. One was the deflection of the glaring rays; another the dimming of them, and the third the shading.

V. G. APPLE:—If we all used lamps with the colored reflectors, it would help considerably.

C. W. MCKINLEY:—By using a proper bulb and a reflector not as highly polished as the present ones, we might arrive at a satisfactory light.

W. H. CONANT:—Mr. Chairman, does not this subject divide itself naturally into two parts, lighting for city driving and lighting for country driving? There are few large cities in which there is any need of glaring head-lights today. They do seem to be essential in country driving. Is it not possible that we can suggest some action that will separate those two features?

N. B. POPE:—I believe that is right, Mr. Chairman. I have been thinking on the same lines and wondering if I could put the thought in such form that it would not seem too radical for action, not necessarily by the Society but by engineers individually. I believe that at present we are designing for the extraordinary requirement of head-lights rather than the ordinary requirement; by which I mean that a very large percentage of the average motorist's driving, as Mr. Conant has just suggested, is done under conditions where a bright searchlight is not necessary and where a uniform and well diffused illumination of the road immediately in front of the car would suffice. Such a light, I believe, could be designed without producing an extraordinary amount of glare, by diffusing the light; spreading it out to the sides of the road and directing it downward on the ground. Possibly to do that it would be necessary to abandon the present

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forms of reflector. I believe it should be possible to develop a glareless lamp that would satisfy all normal requirements for average use. Were that requirement satisfied it seems to me possible that for what I have termed extraordinary use a searchlight could be adopted to be used only when actually required. Our American enthusiasm has led us to believe that the most successful head-light is the one which throws the most concentrated distant beam. That is not the most useful beam under ordinary conditions. We value it most only when we are driving on unfamiliar roads at night, when we can get a long reach down the course. When we cannot get a long reach down the street the concentrated light is rather a hindrance than an advantage, because it turns all the rays outside the road and illuminates something we do not want to see. Therefore I have come to the conclusion that we ought to design our illuminating systems for the ordinary rather than the extraordinary use of the lamps.

CHAIRMAN SOUTHER:—That point is very well taken.

F. A. WHITTEN:—When we first brought out our electric trucks, we put on a head light with a parabolic reflector and had a lot of trouble in some cities, New York City particularly. They would not let us burn those lights at all. The consequence was that we adopted another lamp that had a reflector not of the parabolic type. It gives a remarkably good light and we had no complaints about it from the police. The lamps are set pretty well forward, with nothing to shut the light off from the sides at all. They project beyond the hood and are practically in front of the machine, as they would be on touring cars, but higher up.

K. W. ZIMMERSCHIED:—Mr. Chairman, another question which I think we will have to meet comes in here, namely, the tendency of the designer to try to make one lamp do the work of two. Many engineers have placed a small bulb in the top of the parabolic reflector and called that a side-light, the bulb in the focus of the parabola furnishing the regular searchlight. The rays from these "side-light" bulbs strike the bottom of the reflector and are shot forward and upward into the eyes of those meeting such lamps in a way almost if not quite as annoying as the rays from the focused bulb. There should be, instead, two sets of lamps, and Mr. Pope has outlined exactly what one company has accomplished already. It uses a pair of searchlights that are ideal for country driving, and below this a pair of sidelights, in which the bulb is not put in a focused position; being out of focus, its rays are diffused, and the result is a very soft and satisfactory light for city driving, which illuminates the road for about two hundred feet ahead of the car, spreading to the sides of the road in a manner wholly unobjectionable to pedestrians. It seems to me that this is really the best thing I have seen.

A. L. MCMURTRY:—In regard to the very strong light used in the country, one point has not been brought out. In the State of Connecticut there is a universal vehicle lighting law which is not en-

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forced, and unless the average motorist has a strong piercing light he is apt to collide with some of the wagons at night. I think that about forty per cent. of the head-lights on automobiles are not properly directed; the drivers of cars attempt to get the light on the road by means of focusing rather than by changing the position of the head-light itself, and as a result project the light in a manner that is most apt to dazzle.

As to city conditions, we have an ordinance in New York that requires side-lights; in other words, lamps that will throw light to the sides of the vehicle. A number of cars are fitted with the small lamp in the head-lights, which gives no side light at all. When they come out of a side road into the highway they cannot be seen from a car on the highway except by the aid of its own lamps.

As far as the dazzling effect of glare is concerned, it is simply a matter of contrast between the light itself and the surrounding objects. I think that the best thing the Society could do would be to describe what constitutes a glare, in the terms of candlepower per unit of area, which, in reality, is the intensity of the light. The manufacturers or inventors of dimming or shading attachments will then know the limitations of their devices. It is natural that a man compelled to dim his head-lights will not dim them any more than is necessary to comply with the law. If this Society will give the limitations of intensity of a non-dazzling lamp, the lamp designers will have something on which to base their calculations and the lamp manufacturers will make lamps that will give the automobile owner as much light as possible and still protect the other users of the highway. If this can be accomplished and shall be approved by authorities on the subject of light, when the legislatures are considering enacting laws governing automobile lamps, they will probably adopt the S. A. E. specifications.

CHAIRMAN SOUTHER:—As I have said before, I hope that this matter will be given immediate attention. One curious phase of the situation is brought out by Mr. McMurtry. The very fact that the legislators have not passed laws obliging other vehicle users to carry lights or have not forced them to carry lights after the laws have been passed, is one of the reasons for the existence of the very strong head-light. Do away with that item and it will be a very short time before a far-reaching light is not needed, and a quite strong, diffused light will do all the work that the motorist wants.

A. L. MCMURTRY:—On some cars the tail-light is in the center and on some on the right-hand side. I would suggest the extreme left side of the car for the standard location of the tail-lamp. It is natural in case of car trouble to pull to the right side of the road. The tail-light on the extreme left will indicate to an approaching car the exact position of the stalled car.

N. B. POPE:—Speaking of the position of the tail-light, Mr. Chairman, I want to add that if the Electrical Equipment Division can put forth their recommendation localizing the position of the tail-

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light, it is going to be of great assistance to the Miscellaneous Division in standardizing license tags.

J. J. AULL:—Speaking of the tail-light, how about the single head-light? Not long ago I had an experience on a rough country road with a machine having but one light. We did not know what it was. We guessed it was a locomotive or a motorcycle. It proved to be an immense truck with a powerful searchlight in the center. All we could see was a big light coming towards us. We did not know how much room to give it, but luckily pulled over on the side as far as we could and thus escaped a possible serious accident.

A single head-light on a motor car with no side-lights is certainly dangerous and should not be allowed. A three-light equipment is needed to make a single head-light safe.

A. L. MCMURTRY:—All the motor vehicle laws call for not less than two front lamps.

C. E. DAVIS:—It seems to me that the matter narrows down pretty closely to the vital question of securing uniform legislation in all the States. I believe that this Society can accomplish a great deal in that direction, and eliminate a great many of the points in discussion. If it can indicate a form of legislation which can be recommended to all the States for adoption (along a line similar to that being followed at the present time in connection with boilermaking and maintenance, by the American Society of Mechanical Engineers), it will simplify the matter all along the line.

Wiring Systems

C. W. MCKINLEY:—In connection with the wiring system matter I think the committee might make a recommendation which would not apply specifically to either system, but to both of them; providing that all wires should be enclosed in metallic conduits. An installation of wiring of either kind would then be amply protected against any unusual spark or danger of any kind.

CHAIRMAN SOUTHER:—In that general connection, to help prevent fires and thereby reduce insurance rates, the motor car designer should put the gasoline line shut-off valve where it will be extremely easy to get at; and make the sod pans of such shape that they can not carry puddles of oil or gasoline.

A. L. MCMURTRY:—The one-wire question was brought up some time ago, mainly because at that time there were very few receptacles or fittings made for the one-wire system; and it has been fought through the different meetings of the Division during the past two years. The reason the subject was dropped is, I believe, that it is positively settled by the manufacturers. The lamp manufacturers are selling two one-wire or single-base contact bulbs to one double-base.

As far as encasing the wires in conduits is concerned, I think that in the one-wire cars today, the wiring is installed in a much better electrical and mechanical manner than it has been heretofore in the two-wire.

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C. W. McKINLEY:—In Germany there is an absolute requirement that a man cannot operate a car on a highway without having an auxiliary pan under the carbureter, with a separate drain, so that gasoline flooding from the carbureter will not run into the main pan. The German law also requires a fine gauze screen to be placed in the filler opening of the gasoline tank, to prevent ignition of the gas in the tank. The screen acts on the principle of the Davy lamp used by miners.

W. H. CONANT:—Mr. Chairman, it might be well to introduce into our record at this time the result of a canvass of automobile manufacturers on the subject of one versus two wires. Of those who replied, twenty-seven favor and use the one-wire, and eleven favor the two-wire. Estimating the output of those companies, I figured that approximately two hundred and twenty thousand cars will be built this season equipped with the one-wire system, against approximately ninety-eight thousand with the two-wire.

Bulb Nomenclature

C. E. DAVIS:—I move the acceptance of the recommended nomenclature as to bulbs and lamps.

(The motion was seconded by Mr. N. B. Pope.)

C. W. McKINLEY:—Is the metal base included as part of the bulb? Nothing is said about it.

W. H. CONANT:—It is an integral part of the bulb.

CHAIRMAN SOUTHER:—It seems that the metal part of the bulb should be mentioned.

W. H. CONANT:—I think the Division would be glad to accept an amendment which would include the words "and base."

It is the consensus of opinion of the Division that we should try to avoid the introduction of any new term in the industry, but rather define the words now in common practice, so as to avoid confusion. We avoided the introduction of any new word to describe either of the parts of the electrical fitting under discussion.

(The question was called for.)

CHAIRMAN SOUTHER:—Those in favor of adopting the recommendation of the Division signify by saying "Aye;" opposed, "No." It is a vote.

FRAME SECTIONS

J. G. PERRIN:—The third report of the Frame Sections Division was ready for discussion over a year ago, but in the rush of other business was passed over. I felt, after going over the matter with the frame-makers and the other members of the committee, that nothing more could be done until the report had been discussed by the members, to see if there is any consensus of opinion regarding progress that can be made.

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The frame-makers are very loath to adopt any standard. Only by arriving at some sort of a composite construction with the various frame-makers and automobile builders, have we been able to present anything at all. The report gives in condensed form the result of considerable correspondence. I have letters from all the frame-makers approving the proportions shown.* The different frame-makers have, however, different steel specifications, which vary between .10 and .30 carbon. One maker has a specification running from .20 to .30, another from .10 to .15, another from .23 to .30 and another from .18 to .23. All of them claim that they are having perfect satisfaction with their particular formulas. Of course, for heat treated frames the carbon content will have to be higher. One frame-maker only specifies carbon below .15, and I believe that we should discuss merely the 1020 and the 1025 steels as covering all the desirable ranges for a frame steel.

CHAIRMAN SOUTHER:—That would be from .15 to .30 carbon.

J. G. PERRIN:—Yes. Anything under .15 is really too low.

K. W. ZIMMERSCHIED:—Mr. Chairman, on the subject of material, I think we should emphasize the 1025 specifications. I believe that represents at least seventy-five per cent. of all frames, and especially of the carbon steel frames used for the better class of cars.

On the subject of given depth of side rail as related to the wheelbase, I think we should go slowly. Such data might be used as recommendations for ordinary practice, but any such fixed relation must, it seems to me, be established with considerable thought, taking into consideration also the weight of the car and the distribution of such weight and also the method of installing the different units; that is, the engine and the transmission and the method of carrying the power from the transmission to the rear wheels.

J. G. PERRIN:—The point is very well taken. Since the report was compiled there have been a good many changes in automobile construction. The use of the cantilever spring requires a different frame. The columns in the report relating to wheelbase and depth of side rail were simply an attempt to try to form some proportion between the two dimensions. I realize that they are limited in scope and may be misleading. But if something of that sort could be proportioned, it might help some in the frame-makers in giving advice to people with whom they are doing business. Many people get advice from the frame-maker regarding what tools they have on hand when they want frames quickly. There is a lot of correspondence, the frame people tell me, they asking the automobile manufacturer what the size of his car is. They have formed in their mind a certain relation between the wheelbase and the side rail. The figures would have to be extended a great deal to cover all the different constructions.

* The report is not printed herein, owing to the fact that it is expected that it will be distributed in revised form at the next meeting of the Society. The report was last printed in the December, 1912, BULLETIN.

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K. W. ZIMMERSCIED:—I suggest that in recommending a nickel chromium steel for frames, a note should be added that it is inadvisable to use an alloy steel unless it is to be heat treated; because the return to the manufacturer in life or strength of the frame will not be commensurate with the increase in cost unless it is so treated.

J. G. PERRIN:—That is a good point, too.

F. A. WHITTEN:—Would it not be well to mention in connection with the specification for the steel a recommended heat treatment for the particular purpose?

K. W. ZIMMERSCHIED:—It is better to recommend the physical properties and leave the heat treatment to the manufacturer.

J. G. PERRIN:—There is a relation, of course, in our steel specifications between the chemical composition, the heat treatment, and physical properties to be gained thereby. It was thought that mentioning the steel specification would cause reference to the other points given in the Iron and Steel Division reports.

F. A. WHITTEN:—With regard to the radius for the corner where the horizontal and vertical webs of the channel meet, in my opinion that should be fixed in some way other than by the thickness of the frame, as proposed by Mr. Perrin. A man might have a ⅛" thick frame and want to change it. If this involved a change of radius, it might have some effect on fitting certain brackets to the frame. Would it not be possible to make the radius vary with the frame depth?

J. G. PERRIN:—If you change from 5/32 to 3/16 there would be only a 1/32 difference in radius, which would be very small. Any fittings which are placed inside the channel have considerable clearance, which seems to me would cover such a slight change in radius.

F. A. WHITTEN:—Would it not be possible to make smaller radii for all fittings?

J. G. PERRIN:—Yes.

F. A. WHITTEN:—They could make the dies all alike then.

J. G. PERRIN:—That is possible.

K. W. ZIMMERSCHIED:—It would not hurt the frame to have a larger radius on it, and it would cut down the number of tools that the frame-maker would have to keep in stock, to work on one standard radius.

C. E. DAVIS:—It seems to me that the point just made is correct. I doubt very much whether many frame manufacturers carry more than one die for the same sized frame; in other words, whether they carry a die and fillet to correspond with all the various sized fittings that manufacturers might use. A standard dimension for the fillet would be a decided advantage for the frame manufacturer and would cover the point that was brought out in regard to fittings. It would be a gain to make a standard recommendation that the frame manufacturer would come into line with very readily.

K. W. ZIMMERSCHIED:—I would make the fillet large enough to take care of the thickest section. That would be ¼", would it not?

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J. G. PERRIN:—Yes, ¼" would be satisfactory.

C. W. MCKINLEY:—Quarter-inch frame stock is used very rarely in the smaller sections. I suggest 3/16" radius up to and including 4½ inches and ¼" above that.

K. W. ZIMMERSCHIED:—Why not place it on the basis of the stock used rather than on the depth of the channel?

C. W. MCKINLEY:—Quarter-inch stock is very rarely used in sections below 5 inches. Four-inch section ¼ steel weighs considerably more than 5-inch section 3/16, and will not be nearly as strong.

K. W. ZIMMERSCHIED:—I meant to say, 3/16 up to such and such a gage.

C. W. MCKINLEY:—The frame sections are now made of lighter stock but of considerably greater depth than formerly.

K. W. ZIMMERSCHIED:—I agree with the suggestion that the radius be made 3/16" for all sections below 5" and ¼" for 5" and above.

K. W. ZIMMERSCHIED:—Mr. Chairman, I think we overlooked something when we revised our steel specifications. Perhaps we ought to have retained steel 3225 for use as frame material, although we did retain two other nickel chromium steels, numbers 3220 and 3230.

J. G. PERRIN:—The report will be revised and presented at the next Standards Committee meeting. From what investigation has been made it seems that we cannot enlarge on the report very much because of individuality in frame design. Beyond a certain point recommended practice would be useless.

One point came up today regarding cantilever springs, as to standardizing or at least having something definite for the frame-makers to work to.

CHAIRMAN SOUTHER:—We ought to remember that we have seen the evolution in the freight car frame from wooden sills to bridge construction. I cannot help feeling that there is bound to be an evolution in motor car construction also. The art is changing very rapidly. We are adding aprons between the running-board and the frame. They are doing nothing but keeping mud out. They ought to be working. We are trending toward something different from the frame section which has been a standard for so long. The depth of the truss is something that must be considered. Mr. Perrin refers to spring suspension as changing. It is very hard to tell where the development is going to end. We should keep up to date, putting before our members the detail they ought to have in designing. If there are any originators, we ought to furnish them with that which is good standard practice. The originators will take care of themselves anyhow. They are going their own way in spite of anything we can do.

LOCK WASHERS

J. E. WILSON:—After discussing all the matters which have come before it the Lock Washers Division has arrived at the conclusion that there is no apparent necessity of adding to or changing the

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present S. A. E. Standard lock washer specifications so far as the dimensions are concerned.

We think it would be advisable to specify more strongly the properties of the material from which the lock washers shall be made. This is a matter which requires a little time. It will be taken up by the Division, which will submit later a recommendation for the consideration of the Standards Committee.

CHAIRMAN SOUTHER:—There has been one complaint that the light series lock washer distorted and pulled out of shape. There were two possible reasons for that; that the steel had not been treated up to anywhere near its limit, or had found its way into use in untreated or annealed condition. The fault can be always detected by a very simple test, jamming the lock washer down once, letting it come up and measuring it for height, and then jamming it down again. If there is no difference in height between the first set and the second set, it is fair to assume that the construction is fairly good. Another method is to pull the washer open. If it will not pull open 45 degrees, it is too brittle. Between those two limits is the indication of a perfectly good lock washer. If purchasers will apply the very simple tests specified they will probably succeed in weeding out carelessly made lock washers. It would seem that the quality of the steel had been at fault and not the design.

SIDE-OUTLET CARBURETER FLANGES

J. J. AULL:—The best I can do is to give a brief résumé of what the Carbureter Fittings Division has been doing. Some months ago two or three motor manufacturers suggested the advisability of standardizing the manner of locating the flange on side-outlet carbureters, which are coming into use more and more with the block type of motor. Several members of our committee, who are directly connected with the motor car industry, were at first not favorably impressed with the idea of standardizing these carbureter flanges. But to get some definite action Mr. Behn, chairman of our division, had a print prepared and distributed showing different arrangements.

Fig. 1 shows the pad on the motor, with the bolt-holes on the horizontal center line with the elbow in place. Fig. 2 shows the reverse position, with the bolts on the vertical center line. It is impracticable from the foundry viewpoint to cast the elbow integral with the motor and this construction was not considered at all.

From correspondence which developed it is evident that the motor builders want something definite, either the horizontal method of bolting or the vertical, so that they can locate the pad as far as it concerns the positioning of the bolts. They suggested that the matter be left to the carbureter people, since it made no difference to the motor builder and might make a difference to the carbureter manufacturer. The correspondence shows that the carbureter people prefer the construction shown in Fig. 2 with the bolts on the vertical center

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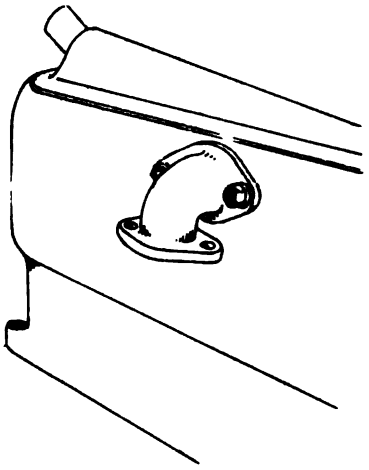

Fig. 1.

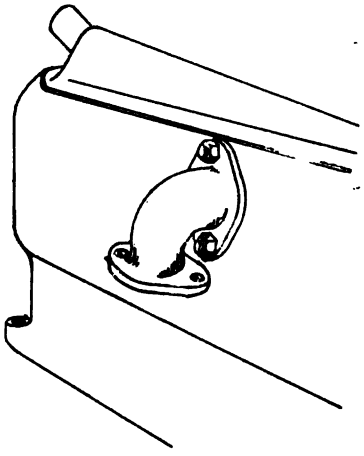

Fig. 2.

line, partly because it is the proper position to give the strongest support and also because with the butterfly-type throttle and when running idle the lower surface of the carbureter outlet would always be swept clean of fuel. A little notch in the lower edge of the throttle disc will give a smoother running motor when idling than if placed in any other position.

So far as the committee has gone it seems that we can safely recommend Fig. 2 as the proper method of arranging the flange and the bolts for side-outlet carbureter. The Division has, however, not voted on the matter.

CHAIRMAN SOUTHER:—Does not the Fig. 2 make the bottom flange bolt very hard to get at?

J. J. AULL:—That is the objection I personally had to it. I favored the horizontal bolting on account of the ease of getting at the bolts but the weight of the arguments favored the other.

CHAIRMAN SOUTHER:—Have the flanges the same dimensions as the present S. A. E. Standard carbureter flanges?

J. J. AULL:—Yes. It is a mere question of the bolting.

Mr. Grimes stated that the horizontal shaft will prevent the deflecting of the gas to either the front or back cylinders, which would cause uneven firing due to rich gas in the front or back cylinders. This trouble often occurs even when a manifold is used and can be overcome by increasing the length of the vertical portion. Since the horizontal type prevents this change being made on account of room under the hood and looks, etc., I would urge that due consideration be given this point before any definite action is taken.

CHAIRMAN SOUTHER:—I cannot see that there is any argument for this position of the bolts.

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J. J. AULL:—The logical way of locating the throttle with the flange bolted this way is with the pin through in the horizontal. When closed off, the disc, of course, is practically vertical with the idling notch at the bottom, thus providing a clear passage for the gasoline collecting on the lower surface of the discharge bore.

CHAIRMAN SOUTHER:—Why could it not be just the same if the flange were in the horizontal position?

J. J. AULL:—You mean to have the throttle stem horizontal also?

CHAIRMAN SOUTHER:—Yes.

J. J. AULL:—I do not know. The carbureter people seem to think that the throttle stem should be at right angles with the bolting. If the throttle stem is parallel with the bolt center line it will interfere with the bolts.

B. B. BACHMAN:—I consider the vertical form of bolting too inaccessible.

JOHN G. UTZ:—If the bolts were run horizontally it looks to me as though they would interfere with the throttle shaft. I should think that 45 degrees would be a good compromise, giving clearance for the shaft and yet making it easy to put the nuts on. Either vertical or horizontal has its objections. 45 degrees seems to work better.

CHAIRMAN SOUTHER:—Why can we not get some samples together to demonstrate the matter?

J. J. AULL:—I see no reason why that should not be done. The subject has not been threshed out exhaustively.

LARGER FLARED TUBE UNIONS

I have two points that I want to put before the Division. The first is that we add the ⅝″ and ¾″ sizes to our standard of flared tubing unions. As manufacturers of these fittings we have had some orders for the larger sizes, not from the motor industry but from outside concerns. But I do not see why the Society should not extend this standard, giving it a wider range by adding the said sizes of exactly the same proportions.

TOLERANCE IN DIAMETER OF UNION NUT HOLE

One further point relates to the clearance around the tube. The present standard specifies a variation of .002″. The hole is .005″ larger than the tube size, with a variation of .002″ more. As this is an automatic screw machine job, .002″ is not enough for practical work. It actually runs about .005″, and I want to propose that the tolerance be increased from .002″ to .005″. That would make the clearance from .005″ to .010″ instead of from .005″ to .007″.

CHAIRMAN SOUTHER:—That is in what diameters?

J. J. AULL:—All diameters, even in the small sizes. The first long type of flare union that I have any knowledge of was made by the Chalmers Company. Mr. Utz will remember it. They used a 1/64-

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inch clearance. If they got along with that clearance, surely we can get along with a maximum of .010" clearance. The point is that .002" is not practical in work of this kind and the standard might as well be practicable as impracticable.

All of these matters will have to be brought before the Division and threshed out and then brought to the next meeting of the Standards Committee as a whole, in the form of a complete final report.

AIR PUMP DIMENSIONS

JOHN G. UTZ:—Information has come to hand that the dimensions of mechanically-driven air pumps for motor cars, accepted by the Society at the January, 1914, meeting have not been put into practice by manufacturers. The census of a large number of cars indicates that these dimensions do not meet with the approval of either the pump manufacturers or the engine builders, and the Miscellaneous Division is of the opinion that the subject should be reopened.

A new element that has come up since the adoption of the standard is the practice of some car makers of supplying the pump on the base formerly used for mounting the magneto. The present standard for the pump base is not the same as the standard base for the magneto. It is found that of eleven dimensions recommended in the air-pump dimension standard, all are used by no one manufacturer, five are used by one or more, and five are not used at all. As it is thought that sufficient time has elapsed since the acceptance of the standard for it to be put into practice, were it available, it is felt that it should now be revised.

It seems that the latest movement in this line is to put a pump on as standard equipment. Most of the pumps now being bought are one- and two-cylinder. The standard pump base which we adopted was big enough to take a four-cylinder pump. In putting on air pumps as standard equipment, the first place the makers examine is the magneto shelf.

It seems that we might arrive at something more useful than the present standard. I think the present standard is a dead issue. All we ask in this report, is to have the matter referred back to committee for further consideration.

CHAIRMAN SOUTHER:—Is there anything to be said on this particular phase of the Miscellaneous Division work?

Is there any objection to referring the matter back to committee? If not, it will be so ordered.

YOKE AND ROD END PINS

JOHN G. UTZ:—The next report is that regarding yoke and rod end pins. We have here samples of the pins if any one cares to see them. In some cases we had cotter pins of different lengths made to show different effects. Measuring a cotter pin is somewhat difficult. There does not seem to be any recognized way of measuring it. But the sizes we have worked out are believed to be correct. The dimensions of

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the head of the pin have been chosen in even sixteenths and eighths, so that it will be possible to buy standard bar stock. The standard as at first outlined called for thirty-seconds, which was bad practice.

COTTER PIN STANDARDIZATION

F. A. WHITTEN:—Our company had I would not say how many cotter pins. We have gone through our stock and cut out the different odd sizes. Instead of carrying about two hundred different sizes of cotter pins we have about twenty in their place. Considerable saving can be made in that way in stocking. It is not necessary to carry all the different diameters of cotter pins, and when those sizes are multiplied by the different lengths you have to use, you get a million cotter pins the first thing you know.

CHAIRMAN SOUTHER:—The diameters of cotter pin used with the S. A. E. standard castle nuts are specified, being 1/16 for a screw diameter of ¼ to 5/16 inch 3/32 for ⅜ screw, etc. No lengths are specified. Five cotter pin diameters are specified in the S. A. E. screw standard.

(It was voted to amend the yoke and rod end pin report by specifying in place of ⅛" a 3/32" cotter pin for the ½" rod, and correspondingly in place of a 28 drill a 36 drill, and 106 diameter of drill size.)

CHAIRMAN SOUTHER:—In connection with the cotter pin work, would it be possible or advisable to attempt to standardize the length of cotter pins for any given diameter of screw body?

F. A. WHITTEN:—It might be possible. My contention is that we should not have the ⅛" cotter an inch, 1⅛", 1¼", 1⅜", 1⅝" long, and all the way along, because I believe it makes no practical difference in a majority of cases whether you use 1¼" or 1⅛" long cotters. If you have both you will have both specified; the fellows will pick out the one that they think just right, and the manufacturer will have in his stock pins of all sizes that can be made.

We found out another thing in ordering cotter pins. A cotter pin is 1⅛" long and the inspector says "that is not 1⅛", it is 1¼"." We will have to find out how to measure the cotter pin, whether from under the head or not.

JOHN G. UTZ:—I find from inquiry of large wholesale houses in Cleveland, that they measure from under the head, where the size begins to exceed the diameter of the cotter itself. In other words, they slide the rule right up along the cotter to where it stops.

F. A. WHITTEN:—That is the method we use.

Effective Length of Yoke End Pin

CHAIRMAN SOUTHER:—Surely the number of sizes of cotter pins can be minimized by a little thought. This is a point well worth working out, it seems to me.

JOHN G. UTZ:—The yoke and rod end pin standard would be desirable to have, so that the screw manufacturers and manufacturers

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of yoke and rod ends could make up a complete assembly and ship it. They want something that they can actually supply. A man ordering some ⅝" yoke ends, could get yokes, pins and cotter pins all together.

H. G. McCOMB:—I would like to make one suggestion. The measure for effective length of this rod and yoke end pin is given to the center of the cotter pin hole. The dimension in which we are interested is the distance from the bottom of the cotter to the bottom of the shoulder. I wonder whether that received the thought of the committee.

JOHN G. UTZ:—That was discussed. The makers of screw machine parts, in making jigs, are interested in the distance to the center of the hole.

H. G. McCOMB:—That would need calculation simply for their jigs. I was thinking of how many times the draftsman would want to use this dimension and say "Well, what is the distance between the shoulder and the cotter pin?"

C. E. DAVIS:—It seems to me that that could be covered very easily by adding one dimension giving the distance to the inside edge of the hole in the various sizes. I mean the side of the hole next to the head. The distance between the under side of the head and the side of the hole would give the clear distance. The computation would be made so that a man would have the figures before him.

B. B. BACHMAN:—I suggest that if that dimension be put on, it be made to an imaginary line, indicating the thickness of yoke, lever or whatever you put on, that it is impossible to exceed and still have clearance to put the cotter pin in. I think that is what Mr. McComb has in mind. We dimension all our pins in that way for the reason that we have found that the draftsman, in figuring the clevis pins with the hole dimensioned, will often stretch his imagination a bit, which is pretty easy to do on paper, but, when he gets on the actual job, takes a lot of fussing. With the new method of dimensioning the clearance is allowed and so the cotter pin can be put in place very readily.

CHAIRMAN SOUTHER:—Could that not be covered by a note?

B. B. BACHMAN:—I think we had better have the actual dimension of the size of the piece that will enter irrespective of the distance to the inside of the hole; as 7/16, the dimension there indicating that 13/32 is the maximum size best to put in on that part.

CHAIRMAN SOUTHER:—Then you would allow 1/32?

B. B. BACHMAN:—Roughly speaking I think that is about right.

H. G. McCOMB:—When we come to use the yoke and rod end pins we are really interested in the thickness of the yoke with which we can use them to advantage. Mr. Bachman's suggestion of putting a line in representing the scope, you might say, of the pin, would fully answer drafting room requirements.

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CHAIRMAN SOUTHER:—The pin is to be standardized for the rod end, which is standard.

F. A. WHITTEN:—But we use the pin for other purposes.

B. B. BACHMAN:—I have taken a 3/16″ pin on the drawing submitted; dimension *D* is 31/64″. The dimension for the size of cotter pin is 1/16″. Taking 1/32″ from 31/64″ leaves 29/64″. I think it will figure several thousandths over that, owing to the clearance of the hole. The width of the yoke taking a 3/16″ pin is just 7/16″; so not very much clearance has been allowed between the bottom of the hole and the side of the yoke to get the cotter in.

F. A. WHITTEN:—Is a tolerance specified for the rod end width?

B. B. BACHMAN:—No.

F. A. WHITTEN:—Then there is a question in my mind whether there would not be trouble in getting the cotter pin in because of insufficient clearance. It is a very rough job, ordinarily.

B. B. BACHMAN:—I think there would be, because it is rough metal. The samples I have secured were usually very rough. I have never measured any of them.

C. E. DAVIS:—For general use it seems to me desirable to know the space between the head and the hole. Then it is up to the man in selecting a pin, to put a piece in that will give him the clearance he requires. You cannot put an imaginary line there, it seems to me, that will fit all cases any more nearly than the actual dimension of a piece of metal to use.

H. G. MCCOMB:—I would like to ask if measurements were made of a number of commercial pins to see how near they came to standard.

JOHN G. UTZ.—No, we were not standardizing the yoke; we merely used the dimensions of standards for the yoke. It might have been better to dimension the yoke in decimals with tolerances.

F. A. WHITTEN:—I believe it would be better to let the yoke stand on the dimensions that are given now, taking the commercial variations as they come. The committee should see that there is ample clearance. We frequently have trouble getting the cotter pin in. The thing is not going to work any worse because of plenty of clearance there, because there is some spring tension on the rods; and it will not get tight if you have ample clearance. The manufacturers of commercial rod ends do not want unnecessarily small limits of manufacture, of course.

JOHN G. UTZ.—The holes were all calculated, using the yoke end dimensions and allowing three thousandths to the edge of the hole. The size of the hole being determined and the center located, figuring that the pin is smaller than the hole in each case, would add a few more thousandths, so that the total clearance would be sufficient to cover all contingencies. That is the basis on which the matter has been worked out, which seems quite logical.

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H. G. McCOMB:—May I ask if there was an actual trial made of rod end pins of these dimensions?

CHAIRMAN SOUTHER:—Yes, we have samples here.

F. A. WHITTEN:—Mr. Davis has made another point which I think is a good one, that in putting two pieces together in this way we introduce still another variable. We make a lever and buy a rod of somebody else; we have a variation there; we put the fork over that and get another variation. The committee should look carefully into the location of the hole and see that we are going to have clearance enough commercially not to have any trouble. I believe it is unnecessary that the yokes should be within .005".

JOHN G. UTZ:—These samples are made right up to dimensions.

H. G. McCOMB:—I believe we would not get that close with the two variables.

JOHN G. UTZ:—You mean in the case of a brake lever yoke?

H. G. McCOMB:—Yes.

B. B. BACHMAN:—We always make the lever end small enough to go in.

CHAIRMAN SOUTHER:—The only thing we can do is to bring this matter to the careful consideration of the committee.

C. E. DAVIS:—It seems to me, Mr. Chairman, that that might be referred back, the same as in regard to the 28 drill.

CHAIRMAN SOUTHER:—Exactly. The matter of the distance between the under side of the head and the nearest edge of the hole goes back to the committee with the request that liberal commercial clearance between the side of the yoke and the cotter pin be allowed.

JOHN G. UTZ:—The only way to make that clearance is to throw everything into decimals. We have not had any decimals yet in the specifications.

CHAIRMAN SOUTHER:—We do not want to make the work any closer. We want to take 1/32 instead of thousandths.

F. A. WHITTEN:—The tool-maker, the man who makes the jigs, is quite used to accurate measurements. What we are really interested in is how easily the cotter pin goes into the hole. We do not really care very much about the trouble the tool-maker has in measuring thousandths, because he does that every day. He is the one man who is thoroughly competent to do that. We want to save not for the man who makes the jigs once, but for the man who puts in thousands and thousands of cotter pins a year; we want to save *his* time. The closeness of the pin to the side of the yoke is of no importance.

B. B. BACHMAN:—Mr. Chairman, I have gone to the trouble of figuring this clearance out. In every case there is just .022" between the side of the yoke, if it be actually within the dimension given on the data sheet, and the inside of the cotter pin, if it be jammed up against the far side of the hole.

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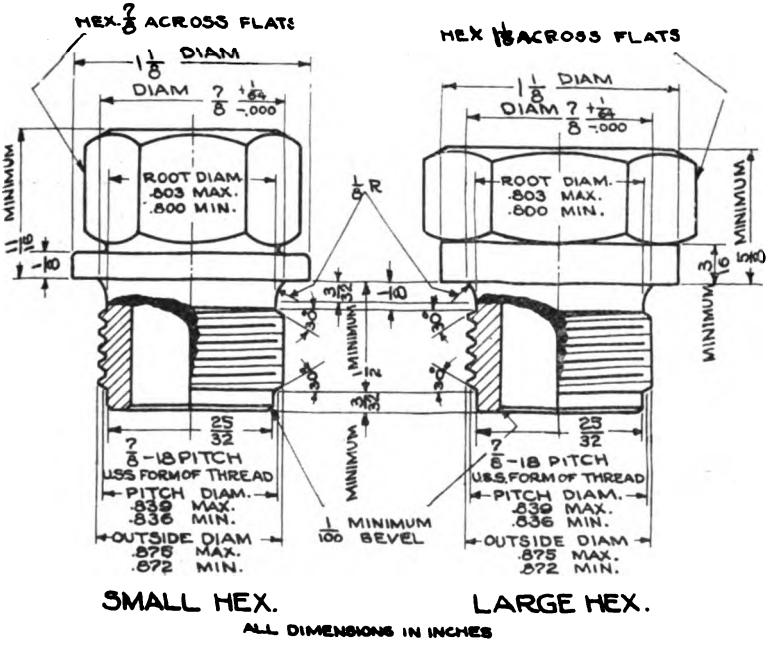
SPARK PLUG SHELLS AND THREAD DATA

JOHN G. UTZ:—The next subject is that of spark plug shells and spark plug thread gages. The two sizes of shell are different above the threaded portions, to permit the use of two sizes of porcelain.



ALL DIMENSIONS BELOW SHOULDER ARE IDENTICAL FOR BOTH SPARK PLUG SHELLS

CHAIRMAN SOUTHER:—Attention should be called to the fact that the new recommendation does not involve a change of the present spark plug standard, but merely the addition of another shell to take a larger porcelain. The larger porcelain has been generally accepted as a good thing. Are there any remarks? Those in favor of submitting the report to the Society at the January meeting, signify by saying "aye." Opposed "no." It is a vote.

JOHN G. UTZ:—If spark plug taps are made to dimensions shown on the accompanying table, the plugs can be turned in by hand, using a wrench only for final tightening. This table of dimensions is quite interesting, inasmuch as it does not refer to a standard thread, as far as limits and tolerances are concerned. A very fine drawn dimension is worked out between the tap and the plug, so as to have a free turning plug that can be put in by hand. We all know what it means to put it all the way in by a wrench. Then the clearances also make it more possible for the plug to pull down the gasket to make the

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THREAD DATA
7/8—18 U. S. S. FORM OF THREAD

	Nominal Dimension	THREAD LIMITS	
		Spark Plug	Tap
Outside diameter.....	.875	.872 Min. .875 Max.	.877 Min. .879 Max.
Pitch diameter.....	.839	.836 Min. .839 Max.	.841 Min. .843 Max.
Root diameter.....	.803	.800 Min. .803 Max.	.805 Min. .807 Max.

Tap Drill Diameter
Nominal 13/16 = .8125
.810 Min. .813 Max.

All dimensions in inches.

seat; whereas, with a tight-fitting thread, with a little lack of trueness in either the thread or the face of the gasket, you would not get a tight gasket. These dimensions have been worked out for that condition. The tap drill diameter recommended makes it possible to buy a 13/16" tap drill and use it until it wears down to .810".

B. B. BACHMAN:—The root diameter of the tap is .805" to .807"; and the nominal diameter of the tap drill is .8125", with limits of .810" to .813". How are these two figures reconciled? The limits imposed on the root diameter of the tap drill are about .005" larger than the limits placed on the diameter of the tap.

JOHN G. UTZ:—You do not get the full thread.

B. B. BACHMAN:—Then what do those figures in the last column mean, the root diameter?

JOHN G. UTZ:—They refer to the tap, not the tap hole.

B. B. BACHMAN:—I thought they refer to the hole dimension.

JOHN G. UTZ:—A point to note is that the tap to be used for the spark plug would not be a good tap to use for tapping 7/8-18 for any other use.

B. B. BACHMAN:—Is it figured out for use in cast iron?

JOHN G. UTZ:—Yes.

CHAIRMAN SOUTHER:—Are there any remarks on this subject? Inasmuch as there is no objection, it will be submitted to the Society at the January meeting for discussion.

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EXTENSION OF THREAD STANDARD BEYOND 1½″ DIAMETER

JOHN G. UTZ:—The next matter of interest is the extension of the screw thread standard beyond 1½ inches. We herewith submit two sizes, to be known as fine and coarse threads; this being the standard for threads only, without any regard to nuts or bolts. The form of the thread is, of course, the U. S. Standard as in the S. A. E. screw standard.

The *coarse* threads to be as follows: beginning at 1⅝″ and advancing by ⅛″ increments and extending to 2⅞″ inclusive, twelve threads per inch.

Beginning with 3″ and advancing by ⅛″ increments to 5⅞″ inclusive, ten threads.

Beginning with 6″ and advancing by ⅛″ increments up, eight threads.

The *fine* threads to be as follows:

Beginning with 1⅝″ and advancing by ⅛″ increments to 2⅞″ inclusive, eighteen threads per inch.

Beginning with 3″ and advancing by ⅛″ increments up, sixteen threads.

This recommendation is presented after a careful survey of the data submitted by twenty-two large motor car manufacturers, together with data submitted by parts manufacturers and tap manufacturers.

Present practice reveals no apparent harmony in the use of large screw threads, and the sizes quoted are suggested as being fairly representative of the practice thus far indicated. Discussion of the merits and demerits of this recommendation is requested.

In working the matter out we had two things in mind: first, a standard easy to memorize; second, two kinds of threads, one for use in cast metals and the other in steel. An examination of the sizes will indicate that we have covered the ground quite thoroughly. We find in the reports from the screw and tap manufacturers and parts makers, some threads running as high as 8″ diameter.

It is interesting to note that in the fine thread division between 1⅝″ and 2⅞″ inclusive, which practically covers the sizes for valve-port plugs, a 2½″ valve (outside diameter) will just drop through a 2⅝″-18 tapped hole. Tap 2⅝″-18 threads and you will just have a nice hole to drop through. That practice is used by a good many manufacturers. It avoids going into sixteenths or decimals, which we find in a great many cases.

The coarse thread standard can be used on bolts, axle shafts, crankshafts and in various places where large diameters are needed on steel. The finer threads will work out nicely with cast-iron. Some desire a coarse thread in cast aluminum; in that case they can use the coarse standard.

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We are making this report as one of progress, for comment or criticism. I hardly think it is ready for adoption.

CHAIRMAN SOUTHER:—Have any drawings or samples been made?

JOHN G. UTZ:—No, because all that we are attempting to standardize is the number of threads per inch.

C. E. DAVIS:—It seems to me that it would be desirable to examine closely the pitches of the finer threads, so that in large diameters they will not be too fine. When seated firmly the fine-pitch thread is very hard to loosen. There is an angle of friction that has been pretty well worked out, which up to a certain limit will "hold and let go." Where you go beyond that angle it is almost impossible to loosen the thread.

JOHN G. UTZ:—We encountered that in discussing this matter. We had before us the railroad standard, in which a finer thread than the regular U. S. standard is used in large diameters. Up to about 8" our coarse threads were within safe limits according to that standard. Beyond 8" diameter there may be the difficulty mentioned.

C. E. DAVIS:—How about the fine threads?

JOHN G. UTZ:—There may be trouble with them also in that respect.

C. E. DAVIS:—In railroad work heavy tools and wrenches are customary. We do not use as heavy tool equipment with the automobile.

F. A. WHITTEN:—We use a great many threads of 5 to 8 inches diameter. These are almost invariably on dust rings and so forth, on which there is no pressure. They are screwed up by means of a spanner wrench and taken off in the same way, without any particular pressure on the threads.

JOHN G. UTZ:—That probably obviates the difficulty.

F. A. WHITTEN:—We use sixteen threads on all hub caps up to 6", if not larger. Sixteen threads is our universal standard for all large diameters on malleable iron, cast steel, etc.

JOHN G. UTZ:—The proposed standard above 3 inches is 16.

F. A. WHITTEN:—That accords with what we have been doing for the last three years on large hubs.

JOHN G. UTZ:—The finest pitch standard proposed is 16 for large diameters.

F. A. WHITTEN:—We use that for holding bearings in place and to take the thrust of the wheel, and have had no trouble with 5" and 6" diameters.

JOHN G. UTZ:—Giving the thread some length, inch or inch and half?

F. A. WHITTEN:—Yes, we have an inch where there is any thrust. The hub caps have a thread at least an inch long. I believe there will be no trouble with the threads as proposed.

B. B. BACHMAN:—Our front axle spindle has 1½" thread diameter. The full-floating axle end has 2½" diameter. In both those

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places we use ten threads. Some years ago we used 16 threads. We found this was absolutely unsatisfactory and changed to 10. I have no means of knowing what 12 would have done. Twelve might have been just as satisfactory as 10. When making the change we made samples of both 10 and 12. The consensus of opinion was that under the circumstances the 10-thread made a very much better-looking job.

F. A. WHITTEN:—We used 12 for those same diameters. So far as I know it has not given any trouble on the axle.

B. B. BACHMAN:—I do not believe it would.

JOHN G. UTZ:—Twelve is very good for steel for that size. We discussed the subject pro and con. Nothing has been mentioned yet that leads very far away from what we have laid down.

B. B. BACHMAN:—I think you are not very far out of the way.

PHYSICAL PROPERTIES OF STEEL

K. W. ZIMMERSCHIED:—Mr. Chairman, the Iron and Steel Division during the past half year or so has been paying special attention to the problem of presenting a set of data sheets which would show the physical properties which can be expected from each steel when given the most widely used heat treatment applied to that specification. Your sub-committee is now able to present tentative tabulations and curves for carbon steels numbers 1020, 1025, 1035 and 1045. These tabulations have been blue-printed and submitted to the Iron and Steel Division as a whole for their criticism, looking toward the formulation of principles which will allow of the extension of the work to cover alloy steels as well. When that work is completed the committee will present the final results for publication. For the benefit of the Standards Committee as a whole I might say that at the summer meeting, and in the BULLETIN reporting the summer meeting, a reproduction of one of these model curve sheets to a small scale was made.

I do not believe it would be of interest to the committee as a whole to go over the principles which we have laid down for our work, as these cover about four typewritten pages. On the sheets which we have drawn are tabulated the minimum physical properties which can be expected under ordinary commercial conditions, using commercial grades of steel, treated in commercial equipment, which is regulated by reasonably accurate pyrometers; and these tabulations are then converted into curves, the abscissae and ordinates of which are percentages in reduction of area and elongation, tensile and elastic limits in thousands of pounds per square inch, and temperatures at which the work is drawn back in quenching.

It is firmly believed that we will have the carbon steel data ready for publication at the midwinter meeting, and that the alloy steel data will follow as soon as we can finish the work.

J. G. PERRIN:—May I ask if the relation between the heat treatments and the physical properties is determined by the average of a number of experiments conducted at the same time?

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K. W. ZIMMERSCHIED:—Yes, we have returns from the members of the committee and their steel companies, and automobile companies who have laboratories, the literature, and so forth.

J. G. PERRIN:—They are the averages covering the possible ranges of steel treatment?

K. W. ZIMMERSCHIED:—The steel treatment, size treated, in fact, all the factors that we could think of.

CHAIRMAN SOUTHER:—Judging from what we have seen here today in committee, it seems that we are getting together from the best sources information as to what can be expected from steels of all kinds. The information will be in such concise form that our members will be able to consult it and select steel which has the right strength and toughness. I do not know of any other place where that information can be had. The task is coming to an end. I really thought there would be no end to it. I thought the problem was too complicated to put on paper. Mr. Zimmerschied has worked it into such shape that I have changed my mind, and I think the Society will be proud of what is to come. Our engineers will have before them in concise form data that will make their work materially easier and more exact.

STEEL CASTINGS

The only other question that has come up before the Iron and Steel Division is that of steel castings. This will probably be handled by considering what shall be done by the American Society for Testing Materials, and adopting their specifications if they shall prove applicable to motor car practice.

CHAIRMAN SOUTHER:—I want to add that there is a movement on foot that the American Society for Testing Materials shall adopt our specifications for steels. There seems to be no great obstacle in the way. If that becomes possible, it will strengthen both organizations very much in this respect.

E. R. WHITNEY:—I understand that the present S. A. E. specifications cover only one carbon in steel castings?

CHAIRMAN SOUTHER:—The American Society for Testing Materials has more.

E. R. WHITNEY:—I understand that they have at least two. Is it the intention to add two or more carbons?

CHAIRMAN SOUTHER:—The idea is that there shall be at least two qualities of steel castings. Whether more shall be necessary will depend upon the deliberations of the committees of the two societies.

SPRING DATA

C. W. MCKINLEY:—The Springs Division finds a great deal of work before it. We have gone back in order to get the meat out of the various reports that have been made to but not adopted by the

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Society. We are unable to report at the present time any recommendations in this connection. We will have a meeting on December 15th, at which we will go into the subject much further, and expect to have a report which we can present at the next Standards Committee meeting. That is as regards leaf springs.

We have had some material on helical springs presented to us by the Data Sheet Division, referring to springs of from 1/5" in diameter, .016 wire, to springs of 5½" diameter, .362 wire. The data give safe deflections for single coils for three different moduli of elasticity; containing a formula and a short method of reducing these deflections which are for round wire, to the same for square wire, and also for brass and other materials. It is the suggestion of the committee that this be turned over to the Data Sheet Division, to be checked and issued in data sheet form.

STANDARD SIZES OF PNEUMATIC TIRES

E. R. HALL:—The first thing the Pleasure Car Wheels Division took up this morning was the consideration of limiting standard tire sizes, which has been suggested in our previous report. We have succeeded in cutting down some forty-six to fifty-four sizes that are listed now, to a list of nine sizes, which will probably include a 36x5, but which we cannot put before you for action just now for the same reason that it was not submitted for action at the midsummer meeting of the Society, namely that the Clincher Automobile Tire Manufacturers' Association has not come to an agreement as to just what the additional 5" rim shall be. This involves the determining of a new rim contour. The matter is now under advisement

R. S. BRYANT:—Mr. Hall, do you not mean the construction of a new width rim not involving a change in contour?

Mr. HALL:—A number of suggestions for an additional 5-inch rim are under discussion. It seems now that it is likely to be a rim of the same profile as the F or 4½" rim, but with a width between clinches half way between the width of the present F or 4½" rim and the G or 5½" rim.

R. S. BRYANT:—Then you are going to maintain the contour of the F-section rim?

INFLATION PRESSURES

E. R. HALL:—Probably. The next thing that we considered was the advisability of standardizing inflation pressures and carrying capacities for pneumatic tires. In view of the fact that this matter is now under consideration in the Clincher Automobile Tire Manufacturers' Association, and that that association is apparently getting to a point where very shortly it will have a standard of this sort, it was deemed advisable for the Society to await the action of the Clincher Automobile Tire Manufacturers' Association, when we could very properly adopt what they thought best.

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RIM STANDARDIZATION

The matter of standardizing rims was next considered. That seemed to be something that a majority of the members of the Division did not like to talk about very much. It seems at the present time that it is an impossible task, and we decided that the best thing to do is to let the rim situation in general take its course for possibly a year, at the end of which time general tendencies may develop a new situation, in which conditions may be much better for standardization than at present. The members of the Pleasure Car Wheels Division are divided in their ideas of what might possibly be standardized in the way of rims, and in that condition we cannot, of course, very well put a proposition to the rim and tire manufacturers.

The report of the committee is simply one of progress, as you see, without anything definite at the present moment.

CHAIRMAN SOUTHER:—The discussion that took place in the committee would be interesting to the other members present here. Take particularly the proposed standard tire sizes, and how to get them used. It comes right back to human nature. We publish a perfectly good thing in every way—so acknowledged by everybody concerned—and then some engineer lays down a car, built around a tire, you might say. He has some fancy that a certain sized tire is a good tire; it does not make any difference whether it is on the standard list or not; and to shake him off of that becomes a very practical problem. I wish we could have that phase of the situation set forth here.

E. R. HALL:—Mr. Chairman, I did not give the sizes that we had in mind because they have been printed heretofore, but I might run over them again. The sizes that are recommended as proper practice for the vehicle manufacturer are all, as they should be, even sizes, allowing the consumer the chance to oversize, if he wants to. They are 30 x 3, 30 x 3½, 32 x 3½, 32 x 4, 34 x 4, 34 x 4½, 36 x 4½, 38 x 5½; with the probable addition of the 36 x 5.

The tire manufacturers will doubtless produce oversize tires for all these sizes, so that if the vehicle manufacturer puts out his car with any one of the standard list tires, and the consumer adds anything to the weight of the car in the way of excess luggage and extra equipment, and wants oversize tires, he can go to the tire manufacturer and get them, 31 x 3½ for the 30 x 3, 31 x 4 for the 30 x 3½, and so on down the list. If a manufacturer equips with any oversize tire, he leaves his customer no chance for oversizing. Incidentally, the customer may want better riding qualities than are possible with the tires furnished on the car. He can obtain these and get the same mileage by putting on an oversize tire and decreasing the inflation pressure.

H. W. SLAUSON:—I believe that one of the strong points of the proposed list is that every tire has its oversize, a size which you may have instead of the tires that you get with the equipment; and

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an important feature of that, I believe, is the increasing tendency of manufacturers to make detachable bodies for their touring cars, thus tending to make the car a year 'round vehicle by adding a sedan or a limousine body, which will weigh from 200 to 500 pounds. The car driver, therefore, is enabled to have an oversized tire that will fit his standard rims for these heavier bodies, and I believe that is especially necessary because these heavier bodies are used in winter when roads are poorer and ruts are deeper and tire wear is greatly increased thereby.

B. B. BACHMAN:—Am I to understand that the 36 x 5 size is to be adopted?

CHAIRMAN SOUTHER:—There is today no legitimate rim to take the 36 x 5.

E. R. HALL:—Every rim company is making a 36 x 5 rim, which has a 4½-inch contour.

B. B. BACHMAN:—Will the action of this Society have any weight with of the Clincher Tire Association?

CHAIRMAN SOUTHER:—It is having its weight.

J. G. PERRIN:—It seems to me that the 5-inch tire would be a decidedly advantageous addition to the list.

C. C. CARLTON:—There has never been a doubt in the minds of the Clincher Tire Association that there ought to be a 5-inch tire. The question has been whether it should be a 36-inch tire or a 37-inch tire, some contending that the rim should be a 36 x 5 and others that it should be a special 37 x 5-inch rim with a wider base than the regular F section.

H. L. BARTON:—The principal difficulty will be to get the car manufacturers to use the standard list after it has been decided upon.

CHAIRMAN SOUTHER:—What is that difficulty, Mr. Barton, if I may inquire?

H. L. BARTON:—Indifference. The car makers can get any size tires they think they want.

CHAIRMAN SOUTHER:—How does this operate?

H. L. BARTON:—To the disadvantage of any standardization. The engineer probably designs a car for a standard size tire. When he gets the car finished, it is heavier than he intended; therefore he puts on an oversize tire. He does not jump to the next even size.

W. T. NORTON, JR.:—Is that a reflection on the engineers, that they do not know what they are going to build?

H. L. BARTON:—It very often works out that way. I think it is probably the universal experience—it certainly is ours—that a car almost invariably weighs more than it was intended to weigh when the design was begun.

W. T. NORTON, JR.:—More than was guessed.

H. L. BARTON:—More than we intended it to weigh when we began to design it. It seems to me that the best possible way to start the movement is for the tire makers themselves to decide on standards

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that they think would be proper and then make a differential in price against the sizes which are not standard. The large concerns can buy any size tires they choose, and get them at the same prices as standards because of the quantity they use. But if the customers could not, they would eventually bring pressure to bear on the car manufacturers.

CHAIRMAN SOUTHER:—That is absolutely the key to the whole situation. Mr. Barton stated it in a very few words very clearly. We have to act through the public and make them say "We do not want anything but standard tires, because we can get them for less than we can get the non-standard." That will very soon discourage the motor car designers and the motor car builders from suggesting anything else.

Do the large manufacturers of cars use any of the tires on the proposed Standard list?

E. R. HALL:—About eighty-five per cent. of the tires used are of the sizes specified in that list.

CHAIRMAN SOUTHER:—There are no freaks on that list.

W. M. NEWKIRK:—I do not then see wherein the objection raised a while ago holds.

CHAIRMAN SOUTHER:—My theory is that the designer does not give enough thought to the subject. He may have a fancy to start with; nobody correcting him, he goes nicely along.

H. L. BARTON:—The point is that the designer will start out with a standard tire and wind up with an oversize tire.

CHAIRMAN SOUTHER:—It surely is wrong to aim at an oversize tire to start with, and I believe it is wrong to permit designers when they do change, to take the oversize rather than the next even size.

R. S. BRYANT:—If this list of tire sizes is recommended by the Society and placed in the hands of all of the engineers, will they not have something definite to work from, rather than their fancy? They will have something absolutely positive recommended by tire manufacturers.

C. C. CARLTON:—As showing the almost hopelessness of the situation, I would say that one of the large car manufacturers started out before their car was even designed, with a determination to put a 33 x 4 tire on the car, whatever the car might ultimately turn out to be. No hope was left of the consumer getting an oversize.

R. McA. LLOYD:—Does the 85 per cent. that was referred to include oversizes?

C. C. CARLTON:—No.

E. R. HALL:—If this Society publishes a standard list of tire sizes, it should show only the even tire sizes and not the odd or oversize tire sizes. The published list will go before the car manufacturers; we want them to use the even sizes. The tire manufacturers will doubtless manufacture oversize tires in every case, for consumers who wish them, and at reasonable prices, but we want to keep the oversize tires

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away from the car manufacturer, insisting that he use a tire from the published list as initial equipment.

H. L. BARTON:—Is it a fact that 85 per cent. of all the tires manufactured are included in the proposed list of standard even sizes?

E. R. HALL:—Yes, approximately 85 per cent.

H. L. BARTON:—Then the other fifteen per cent. ought not to be very difficult to swing.

CHAIRMAN SOUTHER:—This standard tire size propaganda strikes me as one of the most important things we have been able to start in connection with our work, and I believe that we all ought to put our shoulders to the wheel and push it very hard.

INFLATION PRESSURES

E. R. HALL:—The tire companies represented in the Clincher Tire Manufacturers' Association all seem to have come gradually to the conclusion that there should be a new list of carrying capacities and inflation pressures which would take into consideration actual practice among machine drivers and which could more readily be lived up to. This list will probably be a little more stringent in requirements than the present actual average practice, which is hard on tires and which we want to remedy if we can. We assume that if we make a list that is more reasonable than the present list, we can get the consumers to live up more closely to what we desire, than by adhering to the current very arbitrary list. We have in mind allowing a consumer to judge for himself what the inflation pressure of the tire should be and to adjust it within certain limits to the load that he is carrying.

C. C. CARLTON:—I want to explain to the men here who are not living with tires every day what the consumer's problem is. You and I, who cannot afford a big high-priced car, would have a car that runs on 32 x 3½ tires, the standard equipment of the manufacturer. The 20-pound rule gives that tire a 70-pound inflation pressure. Suppose we put on that car 33 x 4 tires. Why do we spend money for those oversize tires? We have two things in mind, probably: greater tire life, greater service from the tires; and, perhaps more important, easier riding qualities. Following the rules laid down by practically every tire company at the present time, we should put 80 pounds pressure in the tires. Is the consumer going to put 10 pounds more air pressure in his tire and retain the same hard riding he had with the 32 x 3½?

The thing that the tire companies are trying to work out, it seems to me, is some method whereby the consumer can get a little easier riding instead of the hard bumps that he gets with the 70 pounds in the 32 by 3½. Personally I am very frank to say that I put a 33 x 4" on to secure easier riding. And I carry 60 instead of 80 pounds pressure. If the load remains the same, it stands to reason that the pressure ought to be lower.

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W. T. NORTON, JR.:—I believe that the average car owner buys oversize tires to increase the mileage. I think that the average chauffeur in New York City would not notice the difference between 70 and 80 pounds pressure in his tires.

C. C. CARLTON:—Yes he would. If I get over 60 pounds, I know it right away.

E. R. HALL:—A great many cars have had tires of insufficient size, which wore out prematurely, thus forcing the consumer to put on an oversize tire in order to get better mileage for his money. If cars were equipped with proper sized tires in the first place, the paramount idea in oversizing would be easier riding qualities.

H. W. SLAUSON:—I have been in touch during the past few weeks with several hundred car drivers who have been dissatisfied with their tires, principally on account of the lack of mileage; in every instance they say "I own a car of a certain weight and use tires of a certain size; my tire mileage is only so much. How can I improve my tire equipment?"

It is a question of whether the owner is running with proper inflation pressure, and also whether he has proper-sized tires. I think that the man who has pursued the subject to the point indicated will try his best to follow out the manufacturer's tables. If he must carry an 80-pound pressure in a 4-inch tire, if it carries a car of one weight, I believe that he will take advantage of leeway given by the tire manufacturer if he says that the motorist need only carry 60 pounds pressure with a lighter car with the same size tires, knowing that his tire life is dependent on the inflation pressure.

I think that most tire manufacturers agree that the percentage of deflection of the tire is the important factor. There is a certain allowable percentage of deflection, some companies say 9 per cent., some as high as 15 per cent. Certainly deflection is directly proportional to the total pressure per square inch, and if a given deflection is allowable, why should a 4-inch tire, for example, be pumped to the same pressure for a 2,200-pound car as for a 3,000-pound car?

I have found that the average tiring of most cars runs between .5 and .6 pound weight per cubic inch of tire volume. I have been asking the manufacturers whether, taking .5-pound pressure per cubic inch of tire volume as normal tiring, if the car weight works out with the oversize tires as .4 pound, the driver need have only 4/5 of the total prescribed nominally for the tire. I think it becomes to a large extent a matter of the car manufacturer publishing the weight of his car. I think we are coming to that; it is being done a great deal. If he does not publish the weight of his car, there is no way of knowing the relative tire equipment needed—the "tiring factor," you might say. If the manufacturer does not give the weight, the man will weigh the car on the first scales he comes to, and they may be coal scales and he will have a false impression of the car all the rest of his life.

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E. R. HALL:—The under-inflation condition has been recognized for a long time, and it is very unsatisfactory. Another bad condition which exists universally is overloading. In checking the weight of American cars and the size of tires with which they are equipped by their manufacturers, we find that considerably over ninety per cent. of them leave the factories on overloaded tires. We made tentatively a table allowing ten per cent. more carrying capacity than the average table now offered by the tire manufacturers allows, and found that even with this allowance over eighty per cent. of the cars were on overloaded tires.

W. T. NORTON, JR.:—I believe that condition is due primarily to the tire companies. When we get a car built, the tire manufacturer will say "Why, surely, a 36 x 4 tire will carry the car. We guarantee that. We will sign on that basis." That is not engineering; commercialism creeps in." If you can save something on a tire, you are going to save it. The objectionable condition is not attributable to the engineer.

H. W. SLAUSON:—I believe that the man who intends to use oversize tires on his car, wants to put the matter down in dollars and cents, and be shown that he will obtain a greater proportion of increased mileage than the added cost of the oversize tire represents. If the oversize tire costs fifty per cent. more than the original equipment, and he is getting 3,500 miles, he wants to know pretty certainly that for the additional dollars he will get fifty per cent. additional mileage.

CHAIRMAN SOUTHER:—There is something in Mr. Norton's contention. There is more than one way of meeting competition; one way is when pressure is brought to bear by a purchasing agent. The tire maker takes a chance and delivers a slightly smaller tire than he would really like to deliver. That condition is not confined entirely to tires.

H. G. MCCOMB:—I think the practical difficulty is in the use of the inefficient type of tire gage, with a mark to show what the tire pressure is. In garages I would suggest air taps for various size tires. If you went into a garage and found a tap marked "4-inch tires," you would be likely to go to that tap to inflate a tire of that size. It would certainly not be a large undertaking to have the pressures reduced for the various sizes of tire in common use.

Calipers for Determining Proper Tire Inflation

H. W. SLAUSON:—The tire caliper is an instrument with two scales on it, the one on which the original reading is to be made being adjusted for the upper portion of the tire, while the other is the one from which the reading is to be made when it is taken at the point of application of the weight. There is a certain allowable difference in those readings, this being in one make of instrument nine per cent. The lower point of the tire is read on the upper scale, and if the same nominal reading is shown on it as on the lower scale, on which the

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upper point of the tire is read, a nine per cent. flattening of the tire is indicated.

CHAIRMAN SOUTHER:—Permissible flattening?

H. W. SLAUSON:—Yes, a deflection that is permissible. I do not know whether the difference in thickness at different portions of the tire would give sufficiently false readings to throw them off or not. I know that in using the caliper one has to be careful not to include the lettering on the tire—the manufacturer's name. That would give a false reading.

W. T. NORTON, JR.:—The different makes of tires do not have the same outside diameter for a given nominal size.

H. W. SLAUSON:—That does not make any difference. You do not need to know what the tire is.

CHAIRMAN SOUTHER:—The caliper simply gives relative readings between the top and bottom of an inflated tire on a car?

H. W. SLAUSON:—Yes. The 9 per cent. variation is constant on the two scales.

CHAIRMAN SOUTHER:—The reading on the scale is almost self-explanatory. The bottom scale reads "Sectional dimension off the ground." That is so much. You slip the caliper along and at the upper scale you find "Sectional dimension on the ground." The ordinary observer does not know anything except that the reading should be so much off the ground and so much on the ground, with the load on the tire.

H. W. SLAUSON:—The readings of the two scales should coincide. You might read 4⅝ off the ground; when the tire is properly inflated the reading should be 4⅜ also on the scale representing the caliper position at the point of greatest tire deflection.

TAPER ROLLER BEARING SIZES

F. G. HUGHES:—The Ball and Roller Bearings Division met this morning to consider the standardization of taper roller bearings, and bearings of that class, which is the line of work which has been taken by the committee since last spring. We held during the summer a meeting at Cape May, at which one of the members of our committee, a manufacturer of the class of bearings in question, submitted to us two lists; one a list of the bearing sizes in common use covering three hundred odd sizes considered by some necessary for the proper equipment of motor cars today. He also showed, by contrast, a list containing some forty-seven sizes, which he stated in the breadth of his experience would cover all the usual and necessary sizes for the practical equipment of any automobile. Ours is the same sort of problem as the tire committee is up against, whether we shall leave the unstandardized series of three hundred odd sizes or reduce this to a manufacturable list of say forty-seven or fifty or possibly a few more sizes which will cover every conceivable need. We have been in correspondence with practically every maker of this type of bearing,

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asking for his views on a reduced list of sizes. We have had very favorable response from two of the makers, and from one of the makers we have had a recommendation to leave the situation alone, a statement in effect that the standardization in mind would be not only disadvantageous to the bearing manufacturer but also work to the disadvantage of the car manufacturer.

We believe that three hundred sizes are not as good as fifty sizes, if the fifty sizes meet all reasonable and rational requirements. We wish to get recommendations for the decrease of the current list, change of sizes recommended or any improvement of (or comment upon) the list from the bearing manufacturers first. Secondly, we propose to send out a form letter to the largest users of the taper roller type of bearing in the car field, asking them for criticism and comment on the list. After harmonizing the returns from those two series of letters, we hope that we will be able to formulate a list of standard sizes of roller bearings which will be not only a credit to the Society but of great help to the automobile designer.

We wish an expression of opinion from the Standards Committee as to the general desirability of pushing the standardization of taper roller or similar roller bearings. The proposed standardization does not apply, of course, to the Hyatt type of bearing which is in a different type classification. If the Standards Committee is desirous of having the Ball and Roller Bearing Division go ahead with the attempt at standardization, we stand ready to do so. We believe it is unnecessary to maintain a list of three hundred sizes inasmuch as it is conceded generally that fifty sizes will meet every requirement.

THRUST WASHER BEARINGS

We have conferred with several of the manufacturers of thrust washer bearings, and a committee of manufacturers has voluntarily undertaken to revise the present list of sizes and types of thrust washer bearings. This being a very difficult matter, considerable time will probably elapse before we can get together a definite list of acceptable sizes.

Feasibility of Roller Bearing Standard List

CHAIRMAN SOUTHER:—A demand has come from the Society for the taper roller bearing standardization outlined by Mr. Hughes. It is very hard for me to understand the attitude of any manufacturer who says it is best to have three hundred sizes, if a lesser number will do. The annular bearing came here from abroad pretty well standardized as to general dimensions, not as to tolerances; and no one thinks, I am quite sure, of adopting any annular bearing that is not found in the standard list. Fortunately the ball bearing catalogues are all alike, copies of each other; the first having been copied as being a good thing. If we can bring about a similar condition in the field of taper bearings, thrust washer bearings and plain roller bearings, a similar list will work just as well. Of course, there is no

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such list now. A designer of a car makes, say, an axle spindle of a certain diameter, and after everything is designed and ordered, finds there is no bearing just right for it. The bearing maker has to go to work and make a bearing of special bore, special outside diameter, etc. The quickest way to stop that is for us to publish a list that everybody can refer to, just as in the case of the ball bearing list.

B. B. BACHMAN:—How many different sizes of annular bearings are there?

F. G. HUGHES:—Sixty-four.

B. B. BACHMAN:—I thought there were more than that. The origin of the taper roller bearing in this country has rested largely with one company and, as I remember, the original bearing of that company was not for automobiles but horse-drawn vehicles. I can remember very clearly using the first of those bearings in our factory. There has been a great deal of refinement of them since and there has been a gradual addition to the list. I do not know how many bearings are listed, but I never imagined there were anything like the number indicated.

CHAIRMAN SOUTHER:—Mr. Bachman, what is happening in the roller bearing business is this: Starting on any given day there is a certain number of bearings. The next day some bearing manufacturer will design one more bearing. Competition is wanted and the bearing is sent to another manufacturer of taper bearings, who if he is going to get an order has to compete on the new size. So each is adding a new bearing every little while.

B. B. BACHMAN:—Is the list of standards that the Society is contemplating adopting going to remedy this condition? Taking our own method, I have in my desk, for instance, a copy of a bearing manufacturer's list; if I am going to do any new work and contemplate using taper roller bearings, my natural course is to use one of the bearings listed. Every bearing we use anywhere in a car is included in the list I have in mind. If another manufacturer wanted to get business from us along those lines, his bearing would have to be interchangeable with a listed bearing and would therefore not increase the number of sizes in existence. If, on the other hand, the designer departs absolutely from any published list, and the manufacturer of bearings is willing to meet him, it seems to me that no list we might publish would remedy the condition. It is all a matter of whether the manufacturers are going to go outside the standard in order to meet competition.

CHAIRMAN SOUTHER:—It seems to me that that comes right back to my original thought, that the annular list has been accepted because it was available.

B. B. BACHMAN:—There is a taper roller bearing list.

CHAIRMAN SOUTHER:—A list three or four times too long.

R. MCA. LLOYD:—I disagree with Mr. Bachman altogether about manufacturers' lists in this matter. I think the standards of the So-

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ciety have more and more weight with the car makers. They consult our standards before ordering anything for which we have standards. We ought to push right along with our standards and not leave the development to the manufacturers' lists. If we cannot get the co-operation of all the bearing makers, we must get the co-operation of as many as we can. I am sure Mr. Bachman or any of his assistants would rather scan a list of fifty than three hundred sizes. If we should standardize fifty sizes and some manufacturer had three hundred, I think that most of the three hundred would become obsolete after a while.

B. B. BACHMAN:—It seems to me, from the explanation that has been made here, that a large part of the responsibility for the number of sizes now listed rests with the designer. There is a manufacturers' list of taper bearings which is unreasonably long if taken as a composite. There has been a manufacturers' list of annular bearings also, which was reasonable because it was universal, and the Society has accepted it as standard. For some reason, perhaps because the annular bearing manufacturers have been more strict, the car designer has not secured odd sizes of annular bearings. But he has secured odd sizes of taper bearings.

F. G. HUGHES:—Mr. Chairman, it is no credit to the automobile engineer in general that the annular ball bearing manufacturer has not made three hundred or three thousand odd sizes. I doubt if there is an automobile engineer who has not his own particular idea as to the sizes to which an annular ball bearing should be made. But the annular ball bearing manufacturers the world over have had a very stiff upper lip and turned special bearing propositions down cold. For a long time there has been listed an extra narrow series of ball bearings, with races about wide enough to go over the balls. Since the adoption of the S. A. E. standard list of annular ball bearings everything possible has been done to cut out this special narrow width type. It is hoped to accomplish this by a differential in price.

In the suggested list of fifty odd sizes of taper roller bearings, there is, I think, only one series that is not standard with Timken, the N. D. replacement series. I think that every one of the other sizes is included in the Timken, Standard, Bower and Bock catalogues. We are not suggesting anything new as to dimensions, but selecting the essential bearings from the mile-long list, hoping to establish those as standard or preferred sizes. There does not seem to be any sense in continuing along on the ridiculous present basis, with sizes varying so little. To do so is not an engineering or a commercial proposition. There is no reason why the list in three years from now cannot go around the room three or four times, if somebody has ingenuity to think out combinations with 1/64 differences. The idea has existed in the trade that the engineer should design his spindle and bearing, then call in one or two bearing makers; there being possibly only two of them, they saying, "Yes, we will make this bearing for you at a

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price." Then the bearing is established as a commercial size and added to the list.

I do not think that the proposed list of forty-seven or fifty-seven sizes is going to be perfect the first year, but if we can set up a standard of recommended practice, it will soon become as strong in the trade as the S. A. E. annular list. It will become so advantageous to stick to the S. A. E. standard that nobody will vary from it.

RESEARCH DIVISION REPORT

DAVID L. GALLUP:—The Research Division begs leave to submit the following report of progress made in the investigation assigned to it by the Standards Committee.

TAP DRILL SIZES

Considerable experimenting has already been done by various members of the committee and to such an extent that the latter is of the opinion that, based on this work, to be of the utmost value to the industry, much more should be attempted and in much more detail than has been the case up to the present. So far the experiments have been made with cold rolled bolt stock of about 80,000 pounds per square inch yield point, and nut material of cast brass, cast aluminum and cast iron. About 200 tests have been made in the above, including sizes from 8 x 32 to ½" x 20.

In looking over these results, it is the consensus of opinion of the committee that to properly carry this investigation to completion will necessitate even more preliminary work and involve the expenditure of some money.

To meet this contingency and also to fortify the committee in its investigation, as well as standardize the conditions of test, the following request and recommendations are submitted for approval:

1. It is requested that the Society authorize the expenditure by the Research Division of sufficient money to provide the specimens for test or that arrangements be completed whereby these specimens shall be furnished to the Research Division ready for test; preferably the latter.

The advantages incident to such an arrangement are quite apparent, for all question of variation in material or workmanship will be obviated and the desire to reduce the cost, thereby probably affecting the value of the tests, will not exist.

2. The method of testing in general to be of two kinds:

A. Static.

B. Rotating.

Under A, the test to be of the regulation tension kind.

Under B, the test to be made while rotation of the nut or bolt is accomplished.

This latter is desired for the reason that the results will represent much more closely the conditions met in actual practice.

3. It is further suggested that simultaneously with the tests just

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outlined, there be made investigations involving various depths of hole in such materials as aluminum, brass and cast iron, for the purpose of determining a balance between strength of thread against shearing in a material of less strength than the bolt.

VEHICLE TAXATION FORMULA

Your committee begs to state that it has given the matter of a vehicle taxation formula careful preliminary study and as a result believes the following factors may be involved in such a formula:

1. Horsepower; 2, total weight of loaded car; 3, gear ratio; 4, speed; 5, type of wheel.

In determining the proper weight to give these and other possible factors, the committee proposes to avail itself of government work by the Bureau of Good Roads, as well as of published results by other societies, and report at a later meeting.

Three types of vehicles are being considered:

1. Pneumatic-tired vehicles.
2. Solid-rubber-tired vehicles.
3. Horse-drawn vehicles.

In this connection it may develop that several factors will be given three different values for the three classes respectively, or that three distinct formulas may be developed.

(Vice-president Zimmerschied assumed the chair.)

CHAIRMAN PRO TEM ZIMMERSCHIED:—The Society has up to this time depended mainly for its information upon manufacturers or upon parties interested in the tests made or in the results obtained. We have here a new Division which is made up of men who are disinterested parties, men who are connected with institutions of learning, and are not in a position to obtain quantities of material or to command the equipment of commercial manufacturing establishments for turning out their test-pieces and so forth. It would seem that if the Society can give them the help requested in one form or another, it is certainly incumbent upon it to do so. I personally feel that an indirect method is preferable. Our shops are able to turn out test-pieces with regularity and at a cost very much below what we could expect from an experimental laboratory in connection with a university. I think that a very practicable plan by which this can be accomplished can be contrived.

With regard to the method of testing a bolt by rotating the nut, I understand that this is simply to measure the strength of a bolt, using something like a wrench on the nut in order to cause failure.

DAVID L. GALLUP:—The time when either the bolt or nut is broken, is usually when being screwed up. The idea was to get a comparison if possible between the so-called static test, where the nut is simply screwed on and the bolt broken or thread stripped, and the rotating test in which the nut is turned at the same time that the load is applied, in which case the bolt or nut would fail earlier.

CHAIRMAN PRO TEM ZIMMERSCHIED:—Without going into the de-

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tails of the test, that would be rather easily done by placing the bolt in the testing machine and applying a certain initial load, and then causing failure by actually turning the nut with the wrench, meantime measuring the load as it increases.

DAVID L. GALLUP:—That is the situation.

CHAIRMAN PRO TEM ZIMMERSCHIED:—I know that this is valuable and much needed information, because, as Professor Gallup points out, a large number of failures take place on tightening up the nut. In addition, suppose an assembly is made with the stresses calculated for the bolt on the basis, we will say, of an ultimate strength of 40,000 pounds; a workman comes along and puts a 12-inch wrench on the nut and draws it up as tightly as he can. He may have put upon that bolt a 35,000-pound load at the start; and only 5,000 pounds to be added to cause failure—a very bad condition of affairs.

Are there any remarks about the work of the Division? If not, its report will stand as one of progress, and the Council, taking cognizance of the requests made, will formulate some program by which the work can be carried out to the satisfaction of the Society.

H. G. MCCOMB:—In that connection it seems to me it might be apropos to give a limit of length of wrench used in tightening the nuts of various sizes. A rough standard is better than none at all. At the present time we have none at all. For example, put a man at assembling connecting-rods, and give him, let us say an 8-inch wrench to put the nuts on.

CHAIRMAN PRO TEM ZIMMERSCHIED:—Are there any additional ideas upon the vehicle taxation basis formula? This is a very much involved subject and one that we cannot get very far with, probably, at this time. It seems to me that the committee will have to give it several months of hard consideration before they will be ready to really recommend anything.

DAVID L. GALLUP:—Any formula that may be evolved by this discussion should be, as I have said many times, absolutely unassailable. It is impossible to take into account all of the factors that actually affect the destruction of the road. What we have to do is to make the formula as general as possible and hit as few individuals as may be. You might take into consideration the time a man operates his car, but it is clear how impossible it is to make any equitable arrangement in connection with that; the man with a five-ton truck might say "I was not carrying five tons,—I had only two." We must charge him with all of the capacity of his truck in order to be fair to all concerned.

There is no question but that more horsepower means more destructive effect on the road. Gear ratio also makes a great deal of difference, because this represents the accelerating ability and therefore the torque and the tractive effort at the start; and the speed of the car in addition. Just how these factors are to be taken into consideration we are not definitely certain as yet.

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H. W. SLAUSON:—Is there to be any relation between weight and area of contact?

DAVID L. GALLUP:—The type of wheel is supposed to take that into consideration.

J. G. PERRIN:—Does the gear ratio have any real bearing on the matter?

DAVID L. GALLUP:—I think so, with a 40-horsepower car with a gear ratio of 3½, you get a certain effect; if you have a gear ratio of 6 you will have an entirely different effect. I do not say it would come in directly; it might be the square or cube root or one-half power.

ELECTRIC VEHICLE MATTERS

ARTHUR J. SLADE:—Since the submission of the last report of the Electric Vehicle Division to the Society, at the June, 1914, meeting, the sub-committees on Motors and Controllers, on Batteries, Wiring and Charging Appliances, on Lamps, on Speed and Mileage Ratings and on Tires have been actively prosecuting their work, which has consisted in large measure in the collection of statistics and statements of established practice. The members of the Division, although widely separated geographically, have taken an active interest in the work of the Division and either personally or by correspondence secured and contributed much valuable data.

The last meeting of the Division was continued during three sessions, the following having been present: Arthur J. Slade, chairman; J. R. C. Armstrong, H. S. Baldwin, W. H. Conant, Walter A. Holland, William P. Kennedy, E. J. Ross, Jr., C. A. Ward, E. R. Whitney, F. A. Whitten, G. W. Wesley.

The Sub-committee on Motors and Controllers (Walter E. Holland, chairman), made a preliminary report discussing particularly the standardization of two motor voltages which it is contemplated will be recommended for adoption at a future date, namely 60 to 66 volts and 80 to 85 volts.

The standardization of name-plates was also discussed, and recommendations will be made later. Discussion was also had on the testing, ampere-rating, insulation, etc., of controllers.

Mr. Dana Pierce, Electrical Engineer, Underwriters' Laboratories, Inc., attended the meeting as a guest of the Division. He stated that a committee of the Underwriters' Laboratories had been appointed to investigate fire risks in connection with electric vehicles and gasoline vehicles having electric equipment, and that his organization was not informed as to good current practice or as to the elements of fire risks existing in these classes of vehicle; and requested the co-operation of the Society through this Division in accumulating data by which the underwriters would be enabled to formulate a code. After extended discussion of methods of accomplishing this end, Mr. Pierce agreed to prepare and submit to this Division a list of questions covering current practice on the features which they consider essen-

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tial and on which they wish advice as affecting fire risk. Upon receipt of this list of questions the Division will refer same to the appropriate sub-committees for suitable action.

Mr. Wesley, reporting for the Sub-committee on Batteries, Wiring and Charging Appliances, made a general progress report. Later recommendations will be submitted on a wide range of subjects, including grouping of cells in battery trays, number of cells in standard battery equipments, with the intention of recommending forty-two cells lead and sixty cells Edison, wiring sizes, insulation, charging receptacles, fuses, polarity of battery terminals and other allied matters.

Mr. Fend, chairman of the Sub-committee on Lamps, was unable to be present and recommendations regarding lamp bases, voltage and other matters will be submitted in a later report, depending to some extent upon the adoption of standard battery voltages.

SPEED AND MILEAGE RATINGS

Mr. Whitten reported for the Sub-committee on Speed and Mileage Ratings, and, after long discussion, the following recommendations were adopted by the Division for submission to the Standards Commitee for acceptance:

"Electric vehicle speed ratings shall be based on continuous operation with one-half load over hard, smooth and level roads or pavements at the actual average battery voltage.

"Electric vehicle mileage ratings shall be based on the rated five-hour discharge capacity of the battery and a continuous run with one-half load over hard, smooth and level roads or pavements."

EFFICIENCY TESTS OF SOLID TIRES

Mr. Whitney reported for the Sub-committee on Tires, describing extensive tests of tire efficiency made by himself and others. These tests were made with both the scleroscope and Whitney tire tester, and also checked by road performance. As a result of these tests and the recommendation of users of the Whitney instrument, the Division recommends the use of the Whitney tire tester for determining the efficiency of solid rubber tires.

This sub-committee is investigating the subject of hardness and other qualities in solid rubber tires and will report further at a later date.

A number of new matters were brought to the attention of the Division and referred to the appropriate sub-committees, among these being the standardization of electrical features of industrial trucks, which will be reported on subsequently.

(Mr. Souther resumed the chair.)

CHAIRMAN SOUTHER:—Are there any remarks on this report? Mr. Slade, do you want any direct action?

ARTHUR J. SLADE:—The Division has two recommendations to

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make. One is the adoption of our report on speed and mileage ratings.

CHAIRMAN SOUTHER:—Are there any remarks on this particular recommendation? Is there any reason why it should not go before the Society as a whole at the January meeting? Unless there is some objection to the report, it will be handed to the Society in January. There are no objections.

ARTHUR J. SLADE:—The Division recommends the use of the Whitney tire tester for determining the efficiency of solid rubber tires.

CHAIRMAN SOUTHER:—Is there any objection to the same action in regard to this? There is no objection.

STANDARDS EXCHANGE WORK

K. W. ZIMMERSCHIED:—There are other organizations which are trying to standardize things in connection with automobiles, and it is the function of the Standards Exchange Division to keep in touch with all the standards which are being set up by this committee and to try as far as possible to harmonize those with the standards being set up by these other organizations. Just at present we are working most assiduously with the motor manufacturers, and as they have standards of their own, we are trying to make theirs and ours as consistent as possible.

We have a couple of other matters in which there has been good co-operation. The American Society for Testing Materials has an Automobile Steels Committee, and we are assured that the standards which we set up will be accepted practically *in toto* by this organization. The same society also has a Spring Steel Committee, and we are working in close harmony with them on spring steel specifications.

BELL HOUSINGS DIMENSIONS

A vital question before the automobile engine builders now is the subject of standardizing bell housing dimensions. We obtained a tentative list of dimensions, which had been previously set up as rather informal standards by the motor manufacturers. This list was made up in blueprint form and sent to all of the manufacturers interested. They were asked to submit data in order that we might find out how much practice coincided. We listed five different sizes, ranging from the largest that might be used on a truck, where a large flywheel is an important factor, down to a small bell housing, which is used on the little cyclecar type of four-cylinder motor. Tabulating these returns, we find that there is practical unanimity on all the sizes, except the largest (which is manufactured to a very slight extent and on which there need be no argument one way or another) and on the smallest, where the standards suggested by the committee do not seem to coincide with current practice. The work of the committee then will have to be focused during the next three months on this small size, in the effort to obtain some unanimity of opinion on what those dimensions should be.

There is one other point that caused a great deal of discussion by

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manufacturers and that is the method of aligning the tailshaft or the end of the crankshaft of the motor with the transmission shaft. This is generally done by machining a pilot shoulder in the bell housing, into which the shoulder on the transmission case enters. Lately, however, some designs have been brought out in which this is not done. That is, the circle is not a continuous one, but a lug is provided, in which a dowel is placed, and then the transmission case is lined up by means of two reamed holes which slip over these dowels.

This practice has elicited a certain amount of adverse criticism from some of the transmission manufacturers who do not make that type of joint, and the committee will also have to concentrate on this subject, to see whether we can establish a new type in which these dimensions will be standardized, or whether they will have to be left as an extraordinary construction.

I may say that what we want to do is to get a motor on which any maker of transmissions can fit his transmission interchangeably. You see that unless we do set up standards of this sort, there will be a continued amount of large tooling expense and a cutting down of competition between transmission manufacturers.

MOTOR SUPPORT ARMS

While the committee was at this work they considered also the possibility of standardizing the reach of the motor support arms on the rear end of the motor and the drop between a base point on those arms and the center of the crankshaft; the idea being to make these arms as narrow as possible, so that motors will be interchangeable simply by putting in different sized brackets to fasten the motor to the frame.

We find that there is a considerable difference on different motors in these dimensions; in fact there are very few motors that coincide at all. Yet every manufacturer wants some standard, since it causes him a great deal of trouble and expense to shift his motor arms to suit every car designer's ideas. We think that by taking the narrowest possible arm and giving the least possible drop, we can accomplish this end, and the work of the committee will consist in part of drawing up a tentative set of deminsions on these points and submitting this also to both car designers and engine builders for their approval during the next few months.

CHAIRMAN SOUTHER:—Gentlemen, you have heard this report. Are there any remarks or any further developments that ought to be brought out at this time for the Society's attention? The Divisions get the greatest possible assistance from the suggestions of just such meetings as this. The transmission builders have urged repeatedly that a standard bell housing be arrived at as soon as possible. The new dowel-supported construction instead of a complete circle between the engine and the transmission, seems to be the forerunner of other designs. There is some tendency towards an engine design wherein the engine is a complete unit from the crankshaft up, so to speak,

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and self-contained, and if hung in the air or otherwise suspended would operate, with the exception of perhaps the lubricating system, the lubricating system being supported by means of a sheet steel or aluminum pan having nothing to do with the strength of the motor as a unit. This is the excuse that I get for the departure from the bell housing. Where it is going to lead is not at all clear.

C. E. DAVIS:—This matter has come up with a good deal of earnestness, as the chairman just stated. We had the point carried so far with certain manufacturers in connection with power transmission and the alignment that they asked us to make a test whereby after the motor manufacturer had bought his case and then scraped in his boxes, we would be prepared to locate our transmission within a certain limit of accuracy with that scraped-in box. That brings in a personal equation which is very difficult to meet in either the doweled case or the rabbeted case, as described by the chairman. Of course, it is possible that the reaming can be done and possibly a little closer accuracy gained with the dowel; for one manufacturer we had a reaming gage made which was slipped on to the shaft after it was scraped-in and placed. The final reaming for the dowel holes in the engine case was made from each individual shaft; and the same gage had to fit the dowels in the transmission case.

The rabbeted case is a little easier for both the engine manufacturer and the transmission manufacturer, if the question of the exact alignment of the shaft after it is scraped in the boxes is not taken into consideration.

I think that the dowel construction to which the chairman referred was first adopted largely in connection with a two-arm transmission, in place of a bell transmission. That led up to the point of a metal underpan that had not a complete rabbeted bell housing to dowel in place. It never has appealed to me as an insurmountable difficulty, however, to cover the rabbeted construction, because of the fact that in all bell housing, whether the oil-pan is pressed steel, aluminum or whatever it may be, the bell housing always passes the center line, covers more than a semi-circle; as a consequence the rabbeted housing will locate properly in either event, the only question being to make the lower part of the pan oil-tight under those conditions.

For cheapness of construction the rabbeted housing is I think better, but where you have the question of aligning perfectly with the head of the shaft after it is scraped in place, then the reaming gage lends itself to the dowel pin method.

J. G. PERRIN:—Does not the bell housing standardization depend somewhat on the form of clutch used?

K. W. ZIMMERSCHIED:—I may say in that connection that the committee furnished two groupings only, two sizes, to be used with the cone clutch, but five sizes for disc clutches. It seems that all the sizes covered by cone clutches can be boiled down to two. This was concurred in by every manufacturer of engines.

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C. E. DAVIS:—There has been a good deal of study of that part by the manufacturer of transmissions; also in designing a multiple-disc clutch and a cone clutch which can be used interchangeably in the same bell housing. A number of designs have been worked out in that way. The question with the multiple-disc clutch depends on whether you use the large diameter and few discs or the smaller diameter and a greater number of discs. In the latter case, a larger range of sizes is called for.

PISTON RING GROOVE DIMENSIONS

K. W. ZIMMERSCHIED:—One other problem was brought before the Standards Exchange Division, on which I would be very glad to have the views of the members present; that is, the standardization of the piston ring groove in pistons, as to depth and width. Do the members present think there is any chance of doing that; not trying to standardize the piston rings at all, but the width and depth of the groove as related to different piston diameters?

J. G. PERRIN:—I think that could be done in this way: The eccentric ring being generally a little thicker than the concentric ring, two depths could be settled on. The new type of thin steel ring would probably work in the same groove as the eccentric ring.

CHAIRMAN SOUTHER:—I believe that is something that can be done.

K. W. ZIMMERSCHIED:—I understand that there are over thirty variations of widths and thicknesses of piston rings.

CHAIRMAN SOUTHER:—I see no difference with the steel ring, Mr. Perrin, because it would be a very easy matter to make a cast-iron groove of definite malleable or steel ring thickness.

J. G. PERRIN:—I meant to have just two depths. The steel ring would probably require a little bit deeper groove than the concentric ring. But the eccentric ring depth would, I think, be proportionate to the steel ring requirements.

CHAIRMAN SOUTHER:—I think that will be found to be true. There is apparently no reason why the piston ring should be of any peculiar width.

J. G. PERRIN:—No, there is no reason why quarter-inch or three-sixteenths should not cover a considerable range in diameter.

CHAIRMAN SOUTHER:—I think that is a thing that the committee can work out very nicely. Be a little arbitrary about it and put out a proposed list and see if anybody can pull it to pieces. I doubt it very much, on engineering grounds.

C. E. DAVIS:—The number of rings would have a bearing, would it not?

CHAIRMAN SOUTHER:—Yes, I think it would, but even that need not matter much.

C. E. DAVIS:—No, it does not make much difference. The rings are practically all between 3/16″ and ¼″. We very seldom find them above ¼″, except for very large diameters. If we want to take into

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consideration small cars and cyclecars, we will have to go down below 3/16" to make rings possible for the very small bores. But three or four widths and a couple of diameters for each width, are about the maximum, making altogether probably eight or ten sizes.

COKER F. CLARKSON,
Secretary

CHANGES OF ADDRESS OF S. A. E. MEMBERS

Allen, Harry, formerly designing engineer, Field Omnibus Co., New York City; now assistant chief draftsman, Ferro Machine & Foundry Co., Cleveland, Ohio.

Baninger, John H., formerly mechanical engineer, Willys-Overland Co., Toledo, Ohio; now mechanical engineer, Gurney Ball Bearing Co., Jamestown, N. J.

Barron, R. C., formerly checker, Gray & Davis, Inc., Boston, Mass.; now checker, Ferro Machine & Foundry Co., Cleveland, Ohio.

Brown, Garnet C., formerly engineer, Buffalo Electric Vehicle Co., Buffalo, N. Y.; now in engineering department, Packard Motor Car Co., Detroit, Michigan.

Cermak, J., formerly efficiency engineer, Fairbanks Morse Electrical Mfg. Co., Indianapolis, Ind.; now engineer, Premier Motor Mfg. Co., Indianapolis, Ind.

Churchward, A. Gray, formerly assistant engineer, Gray & Davis, Inc., Boston, Mass.; now connected with Fred E. Holmes Co., Detroit, Michigan.

Clarkson, E. P., now district representative, Canada, Dodge Bros., Detroit, Michigan.

Corse, Hugh R., formerly Detroit representative, Lumen Bearing Co., Buffalo, N. Y.; now sales representative, The Titanium Alloy Mfg. Co., Niagara Falls, N. Y.

Cox, Ernest C., formerly connected with Findeisen & Kropf Mfg. Co., New York City; now connected with Spindler & Derringer, Jersey City, N. J.

Dean, Arthur M., formerly connected with Palmer & Singer Mfg. Co., Long Island City, N. Y.; now in motor department, Ferro Machine & Foundry Co., Cleveland, Ohio.

Duesenberg, F. S., formerly connected with Sears Automob le Co., Des Moines, Iowa; now with Duesenberg Motor Co., St. Paul, Minn.

Farrington, Henry, formerly editor, "Power Wagon," Chicago, Ill.; now in motor truck department, The Thos. B. Jeffery Co., Kenosha, Wis.

Fijux, Louis B., formerly assistant manager, Detroit office, Willard Storage Battery Co., Cleveland, Ohio; now Detroit manager, Bijur Motor Lighting Co., Hoboken, N. J.

Johnson, Alfred, formerly factory manager, R. C. H. Corp., Detroit, Mich.; now works manager, Ingalls-Shepard Forgings Co., Harvey, Ill.

Keller, Chas. G., formerly inspection engineer and chief draftsman, International Motor Co., Plainfield, N. J.; now connected with Nagle ReBlade Knife Co., Poughkeepsie, N. Y.

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Knepper, H. H., formerly special representative of factory equipment, H. W. Johns-Manville Co., Detroit, Mich.; now connected with National Electric Starter Co., Detroit, Mich.

Miller, Hugh, formerly draftsman, Warner Gear Co., Muncie, Ind., now connected with Remy Electric Co., Anderson, Ind.

Moore, Joe W., formerly assistant chief engineer, Empire Automobile Co., Indianapolis, now owner of a repair and rebuilding shop, Indianapolis, Ind.

Osburn, Harry G., formerly mechanical and electrical engineer, National Metal Molding Co., Economy, Pa.; now consulting engineer, National Metal Molding Co., Pittsburgh, Pa.

Pope, Chas. S., formerly engineer, Spaulding Mfg. Co., Grinnell, Iowa; now in engineering design department, Hupp Motor Car Co., Detroit, Mich.

Rausch, K. F., formerly layout and detail man, Pittsburgh Model Engine Co., Peru, Ind.: now chief draftsman, Peru Auto Parts Mfg. Co., Peru, Ind.

Roberts, W. H., formerly assistant engineer, Department of Finance, New York City; now connected with Board of Estimate and Apportionment, New York City.

Rockwell, W. D., formerly sales manager, Champion Ignition Co., Flint, Mich.; now sales agent for Universal Machine Co., Bowling Green, Ohio, and E. J. Copeland, Detroit, Mich.

Taylor, Wm., formerly designer, Chalmers Motor Co., Detroit, Mich.: now chief draftsman, New Dominion Motors Co., Walkerville, Ontario, Canada.

Toaz, Glenn A., formerly designer, Northway Motor & Mfg. Co., Detroit, Mich.; now chief draftsman, Maxwell Motor Co., Detroit, Mich.

Wilt, A. D., Jr., formerly vice-president and general manager, The Schweppe & Wilt Mfg. Co., Detroit, Mich.; now connected with the Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont., Canada.

Wood, Lloyd E., formerly road engineer, Milwaukee Locomotive Mfg. Co., Milwaukee, Wis.; now engineer, Duplex Engine-Governor Co., Inc., New York City.

APPLICATIONS FOR MEMBERSHIP

A list of current applications for membership is given below. The members are urged to send for the consideration of the Council any pertinent information with regard to those whose names are given which the Council should have prior to the election of any of the said applicants. It is requested that communications from the members in this connection should be sent promptly.

Badger, F. E., Secretary and Manager, J. B. Armstrong Mfg. Co., Flint, Michigan.

Blackburn, Samuel L., District Manager, A. E. Division, Westinghouse Electric & Mfg. Co., Cleveland, Ohio.

Chesnutt, Ralph C., Chief Draftsman, Motorcycle Factory, Aurora Automatic Machine Co., Chicago, Illinois.

Cincinnati Ball Crank Co., Oakley, Cincinnati, Ohio.

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Corse, William M., Manager, Bronze Department, The Titanium Alloy Mfg. Company, Niagara Falls, N. Y.

Diamond, James E., Engineer, Detroit Plant, Aluminum Castings Co., Detroit, Michigan.

French, Laurence E., Mathematical Engineer, Hupp Motor Car Co., Detroit, Michigan.

Gould, William S., Vice-President, Gould Storage Battery Co., New York City.

Loutrel, Cyrus H., Assistant Factory Manager, National Lock Washer Co., Newark, N. J.

Ridlon, John R., Repair Department Foreman, Chicago Branch, Locomobile Co., Chicago, Illinois.

Suttill, Albert G., Chief Engineer, James Boyd & Brothers, Philadelphia, Pa.

Tower, Edwin B. H., Jr., Patent Counsel for United States Light & Heating Co., Niagara Falls, N. Y.

Whitney, Charles S., Sales Representative, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Winther, Martin P., Truck Engineer, Thos. B. Jeffery Co., Kenosha, Wisconsin.

APPLICATIONS APPROVED DURING DECEMBER

MEMBERS

Budd, Edward G., 502 Westview St., Germantown, Pa.

Harrower, William, Sound View Terrace, East Elmhurst, Long Island City, N. Y.

ASSOCIATES

Chalfant, Edward P., care of Electric Automobile Mfrs. Assn., Chicago, Illinois.

Hansen, H. Albert, 3 Fordham Ct., 218 South St., Jamaica Plain, Mass.

Langston, Chas. R., 1829 McGee St., Kansas City, Mo.

McBrair, Henry C., Middletown, N. Y.

Miller, Joseph A., care of Rutherford Rubber Co., Rutherford, N. J.

Powers, Lansing W., 505 Fifth Avenue, New York City.

Wise, Edward M., 300 Victoria Place, Toledo, Ohio.

JUNIOR

Shepard, Edward M., 1253 Woodward Ave., Detroit, Michigan.

STUDENT ENROLLMENTS

Adams, Robert H., 1038 E. Huron St., Ann Arbor, Michigan.

Bromley, Abraham D., 721 Monroe St., Ann Arbor, Michigan.

Cooper, Howard G., 101 S. Thayer St., Ann Arbor, Michigan.

Gerald, Arthur H., 8 Elbridge St., Worcester, Mass.

Robinson, George W., Jr., 73 Institute Road, Worcester, Mass.

Searle, Russell M., 2163 Broad St., Pawtuxet, R. I.

Smith, G. W., 24 Institute Road, Worcester, Mass.

Watson, Herbert H., 148 Highland St., Worcester, Mass.

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SECTIONS OF THE SOCIETY

DETROIT SECTION

E. T. BIRDSALL.....*Chairman*
C. T. MYERS and W. N. OSBURN.....*Vice-Chairmen*
HERBERT L. CONNELL.....*Secretary and Treasurer*

(Address) 109 Webb Avenue, Detroit, Mich.

Meets first Thursday each month at 8 p. m., in the Employers' Association Rooms, Stevens Building, Detroit, Mich.

INDIANA SECTION

LON R. SMITH.....*Chairman*
R. H. COMBS.....*Vice-Chairman*
CHAS. P. GRIMES.....*Secretary-Treasurer*

(Address) Wheeler & Schebler, Indianapolis, Ind.

Meets first Tuesday after first Wednesday each month at 8 p. m., at the Hoosier Motor Club in the Claypool Hotel, Indianapolis, Ind.

METROPOLITAN SECTION

JOSEPH A. ANGLADA.....*Chairman*
HERBERT CHASE.....*Treasurer*
NIRAN BATES POPE.....*Secretary*

(Address) 1790 Broadway, New York City.

Meets last Thursday each month, except July and August, 8 p. m., at the Automobile Club of America, 247 West Fifty-fourth Street, New York City.

CLEVELAND SECTION

JAMES H. HERRON.....*Chairman*
H. B. ANDERSON.....*Vice-Chairman*
A. J. SCAIFE.....*Treasurer*
R. J. NIGHTINGALE.....*Secretary*
E. R. HALL, J. H. HERTNER, R. H. MANSON.....*Members Board of Directors*

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OFFICERS OF THE SOCIETY

President, Henry M. Leland, Detroit, Michigan.

Vice-president, William Guy Wall, Indianapolis, Indiana.

Vice-president, K. W. Zimmerschied, Detroit, Michigan.

Treasurer, Hermann F. Cuntz, New York.

Chairman of Finance Committee, H. M. Swetland, New York.

Secretary and General Manager, Coker F. Clarkson, New York.

MEMBERS OF THE COUNCIL

Henry M. Leland, Detroit, Mich.
William Guy Wall, Indianapolis, Ind.
K. W. Zimmerschied, Detroit, Mich.
Hermann F. Cuntz, New York.
Joseph A. Anglada, New York.
Harold L. Pope, Cleveland, O.
E. F. Russell, Longmeadow, Mass.
Christian Girl, Cleveland, Ohio.
Henry C. Wilson, New York.
Walter C. Baker, Cleveland, Ohio.
H. W. Alden, Detroit, Mich. (Past President).
Howard Marmon, Indianapolis, Ind. (Past President).

POSITIONS AVAILABLE

The following announcements are published for the information of members of the Society. No charge whatever is made for these announcements. Members who wish additional information will please address the office of the Society:

189. Foundry foreman; one who can handle men and knows foundry business, especially in the cast-iron line.

198. Want layout men with experience in heavy commercial vehicle design.

*199. Male stenographer having experience in automobile manufacture or supply house. Must be familiar with electrical details for motor cars. State details, references and salary in first letter.

*200. A good live man competent to take charge of automobile school. School has ample financial backing supported by both city and state. Salary from $1,500 to $2,000 a year.

(*Concluded*)

*Send written application to S. A. E. office to be forwarded to employer.

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201. Mechanic, operator or tool-maker; experienced in drawing and annealing large brass cartridge cases.

202. Experienced draftsman.

203. Designer who has had active personal experience in the design of high-speed European motors within the last twelve months.

204. Salesman for New England States to look after local dealers. Must be high-grade man who can get results on commission basis. We have a proposition that appeals to all men of ability in selling line.

*205. Man competent to undertake charge of manufacturing department as superintendent. One who is a thorough mechanic, with executive ability; able to meet men and estimate on new work in the line of pressed steel manufacture.

206. Electrical engineer experienced in electrical starting and lighting systems for automobiles. Must be capable of designing such apparatus, and have experience in ignition systems, if possible.

MEN AVAILABLE

0289. Worker with ambition and push, getting results now as for years back, wants to exchange his experience and ambition for a nominal salary and a good chance to get ahead. Years of experience as superintendent, factory manager and purchasing agent.

0290. Would like to connect with research or experimental department of an automobile or accessory builder. Am now holding a responsible position with a well-known company and desire to change only on account of preferring the above-named work. Several years of valuable experience. Exceptionally good on electrical equipment. Quick and accurate in technical work. Married. Age 30.

0291. Managing and designing engineer in high-class construction desires position with large and progressive concern; 35 years of age.

0292. Engineer, 32 years old, desires responsible position with automobile, motor or accessory manufacturer. Twelve years' thorough practical training with large companies.

0293. Sales engineer with broad technical training and practical experience in sales, engineering and production, now handling ignition, lighting and starting equipment for automobiles in Detroit territory, desires opportunity of larger scope in this or other accessory line.

0294. Graduate mechanical engineer. Experience in motor and chassis design, experimental work and general production. Has initiative and resourcefulness. Would make capable assistant to chief engineer, production manager, etc. Location in eastern states preferred.

(*Concluded*)

*Send written application to S. A. E. office to be forwarded to employer.

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NEW DEPARTURE BALL BEARINGS

American Made for American Trade

IF every person interested in the manufacture, sale and use of Motor Cars could visit the New Departure plant he would be well repaid.

IF he could go with us into our laboratory,

IF he could observe the analyses and tests made of our materials and note the results,

IF he could go with us through all the departments of the New Departure plant and then sit down with us for a man-to-man discussion of the subject of ball bearings in all its phases—every such person would then realize the full meaning of our assertion, oft repeated, that New Departure Ball Bearings are

The Quality Bearings of the World

¶ Many have done this—have profited by it—they need no further proof.

¶ There are many who cannot personally investigate New Departure materials and methods.

¶ To such our present advertising campaign in the Trade Papers is directed.

¶ The descriptions and pictures of New Departure materials and processes will cover the entire subject of New Departure Ball Bearings.

¶ Look for these pages from week to week as they appear—They present conclusively a subject in which the Motor Car Industry and the Motorist are vitally interested.

The New Departure Mfg. Company
Bristol, Connecticut, U. S. A.
Western Branch, 1016-17 Ford Bldg., Detroit, Mich.

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ENGINE EFFICIENCY

As obtained by the

Browne Carbureter

Cause. A constant mixture of true proportions.

Reason.	Effects.
1. It is most inflammable.	1. Easiest to ignite.
2. It gives highest cylinder pressure.	2. Greatest power.
3. It is quickest burning.	3. Fastest.

This refers to a gaseous mixture within the cylinder. We must differentiate between the mixture in the cylinders and the mixture in the carbureter, because when the motor is cold, part of the fuel remains in the manifold, and there is no longer a properly proportioned mixture within the cylinders. Under these conditions it is necessary to temporarily supply more fuel. That's what the primer is for.

It is claimed that enrichment is necessary for acceleration, but actual experiment* has shown that at 1000 r.p.m. an engine only increased its horsepower 1.577 per cent. for an expenditure of 48.4 per cent. more fuel.

On suddenly opening the throttle of the average carbureter, the inertia of the air valve and its spring *does* greatly enrich the mixture—frequently to the extent of choking—but

A perfect mixture needs but *slight* enrichment, provided it *is* perfect.

In the Browne the air valve is made as light as possible *to prevent* undue enrichment—choking is unknown—but acceleration or "quick getaway" is in no way sacrificed.

Authorities all agree that the combustion of certain definite proportions of air and fuel vapor liberates the greatest number of heat units from a given weight of fuel.

Any departure from a composition of maximum efficiency means waste of fuel.

Too much air necessitates the use of *more mixture* to produce the desired power.

Too little air means incomplete burning of the fuel.

Either case means loss.

This is proven by the efficiency obtained by true gas-engines, which are easily supplied with a mixture of invariable composition, as against the road performances of automobile engines, commonly supplied with highly fluctuating mixtures.

The comprehensive principle of the Browne makes constancy of mixture possible under all conditions.

*Transactions S. A. E., Vol. 8, Part II., page 206.

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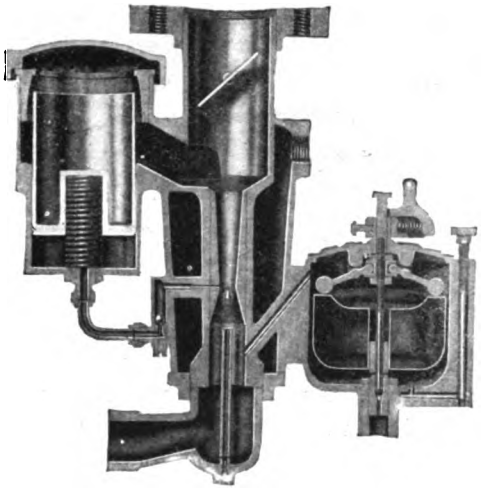

To accurately incorporate these principles in each individual instrument, demands an organization skilled in quantity production.

The factory of the Malleable Iron Fittings Company, Branford, Conn., affords a capacity for the production of Browne carbureters in quantities to meet all requirements.

SOLE SELLING AGENTS:

Holt-Welles Company, Inc.

E. H. Stickels, President

U. S. Rubber Building **1790 Broadway** **New York**

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Wagner Quality

THE STERLING MARK OF THE ELECTRICAL WORLD

An architect does not build a house and then add a heating plant. His original plans show just where every pipe and radiator is to go. He has figured out, in advance, exactly how much radiation is required for each room and what size boiler is needed to provide the required heat in the coldest weather. If he is building in Minnesota he provides more radiation than he does if he is building in Texas. An automobile manufacturer who provides his car with a

WAGNER STARTER
The Starter that is built to order

follows the plan of the architect. At the time he designs his car, he provides for the starter. The exact conditions the starter will have to meet are determined, and a Wagner Starter is built which exactly fulfills the requirements. Nothing is compromised. Being built to order, the Starter can be made right in every particular.

The Wagner Company will be glad to send an experienced engineer to discuss with you the desirability of having a Wagner Starter designed and built for the car you are building.

Wagner Electric Manufacturing Co.
St. Louis

Factory Branches and Fully Equipped Service Stations:

Boston, Buffalo, New Orleans, St. Louis, New York, Toronto, Detroit, Kansas City, Montreal, Pittsburgh, Chicago, Denver, Philadelphia, Cleveland, Milwaukee, Los Angeles, Syracuse, Cincinnati, Minneapolis, San Francisco, Seattle

SELLING AGENCIES: Atlanta, Sioux City, El Paso, Salt Lake City

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Connecticut Automatic Ignition

CONNECTICUT AUTOMATIC IGNITION is without question the most modern and effective system of ignition thus far devised because—

The Connecticut Automatic Igniter delivers its hottest spark at the lowest motor speeds when carburetion demands a hot spark, and its high speed spark is as effective as the magneto's best effort.

It has absolutely no electrical or mechanical lag at any speed.

It has more perfect synchronism than the best magneto.

Its Automatic Switch makes it impossible to completely or partially run down the battery through accident, tampering, or neglect to throw it off.

The elimination of lag admits of extreme simplicity, obviating the necessity of compensating devices, which in turn destroy synchronism and make a sluggish motor, particularly on hill work.

The fact that the 8-cylinder Igniter will fire perfectly at a motor speed of 3000 R.P.M. as well as at the lowest speed at which it is possible to turn the motor over only goes to show its remarkable mechanical and electrical design.

We desire competitive service and dynamometer tests with any Ignition System built.

Made for 3, 4, 6 and 8 cylinder motors.

Catalog on Request

CONNECTICUT TELEPHONE & ELECTRIC COMPANY, INC.

MERIDEN - - - CONNECTICUT, U.S.A.

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Why Houk Wire Wheels Are Best

In tensioning a Houk wheel the hub is held concentric with the rim, instead of being allowed to float. An automatic shaft pulls up each spoke to a certain tension, but can pull it no further. Consequently the finished wheel is not only true, but the spokes are evenly tensioned and each spoke carries its share of the load. Spokes do not break in Houk wire wheels.

In the positive self-tightening Houk lock the hub-cap tightens itself while the spring catch makes it doubly certain that the wheel cannot come off accidentally under any circumstances.

There are many other reasons.

Houk Detachable Wire Wheels

GEO. W. HOUK CO., Buffalo, N.Y.—Also 1792 B'way, N.Y. City

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Announcing the Perfection of

THE GEORGE AUTOMATIC ROLLER BEARING

THE GEORGE AUTOMATIC ROLLER BEARING is a bearing with positive Automatic Adjustment to compensate for commercial variations in *actual* roller diameter so that when assembled each roller presents exactly the same working diameter.

THE GEORGE AUTOMATIC ROLLER BEARING by eliminating the "cage" overcomes the existing troubles of the "cage" construction of roller bearings, and to perform the same function, employs a novel method of separating the rollers, which at the same time produces positive automatic adjustment of the rollers.

The construction of THE GEORGE AUTOMATIC ROLLER BEARING will secure and maintain concentricity when assembled without undue close limits in machining the bearing seat and housing, and may be mounted or dismounted without pressure and being a unit assembly may be dissembled for inspection and cleaning without the use of any tools or the springing or distortion of any of its parts.

How these results are accomplished will be fully described in future issues of the S. A. E. Bulletin.

THE GEORGE AUTOMATIC ROLLER BEARING CO.

Walter H. Miller, Pres. HAMILTON, OHIO

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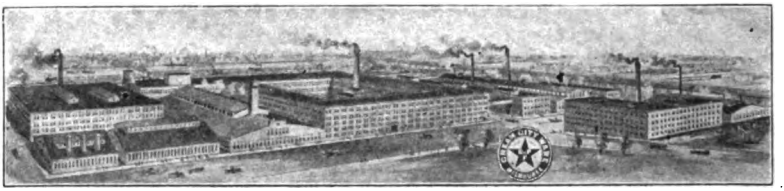
An Open Letter to Automobile Engineers



Gentlemen:

Our Engineering Staff specializes in working out stampings to take the place of grey iron or aluminum castings—or die castings.

Whatever your demands in light or heavy automobile part stampings—Hoods, Clutch Cases, Covers, Joint Cases, Gasoline Tanks, Mufflers, etc.—we can meet them.

We are able to produce high quality stampings at low cost because of our facilities for purchasing materials economically; of our 15-acre plant, equipped with most modern machines; expert labor; of our 34 years' experience in sheet metal work.

Close inspection of all work before it leaves our shop assures of it being **right** in every respect when you get it.

As specialists in Stamping, Drawing and Spinning in Brass, Copper, Aluminum, Tin, Monel Sheet and Steel, and with extensive facilities for Porcelain Enameling—and as an organization equipped and fitted to assure you quality work, low prices, prompt deliveries, we solicit an opportunity to quote on your requirements.

Interesting figures will go forward immediately after we receive your blue prints or sample and know the quantity required.

Very truly yours,

GEUDER, PAESCHKE & FREY CO.

Contract Manufacturing in all Sheet Metals

1365-1700 St. Paul Avenue MILWAUKEE, WISC.

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HAYES WHEELS
DEMAND
YOUR CONFIDENCE

Our plant is equipped with latest automatic machinery throughout.

Our wheelwrights have had life long experience in their work.

Our connections with the source of Timber Supply in the South are unsurpassed.

The Quality of our material is guaranteed.

WE CAN MAKE DELIVERIES

Hayes Wheel Company
Jackson, Michigan

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0295. Engineer, having 16 years' experience in designing all parts of automobiles. Gas engine a specialty. Thirteen years in general manufacturing. Has been chief engineer of a large automobile factory for the past eight years. Will be open for a position Dec. 1st.

0296. Draftsman; eleven years' drafting experience, five designing commercial cars, high-grade and light pleasure cars. Can qualify as layout man. designer, checker or chief draftsman. Would prefer situation in middle west. Twenty-eight years of age.

0297. Designing and manufacturing engineer on medium-priced pleasure cars wants chance as works manager, engineer or superintendent. Fourteen years' practical and theoretical work. Technical graduate in mechanical engineering.

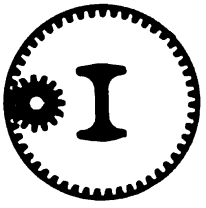
0298. Engineer-writer with long and varied practical experience as designer and constructor of trucks and pleasure cars and in editorial work with a number of trade papers, desires large opportunity in an advertising department, preferably with a firm building both cars and trucks. Write advertising, publicity, catalogs in English and Spanish, booklets, repair parts lists, instruction books, edit house organ, etc. Complete knowledge of printing, engraving, paper, type, etc. Eastern location preferred.

0299. Engineer with experience peculiarly fitting him for the service, desires position with leading company to act as point of contact between engineering department and the service, sales, advertising and publicity departments. Can handle mechanical instruction of salesmen, write instructive books and aid in experimental work.

0300. An active man wishes a position where twelve years' practical experience with carburetion and ignition troubles would be useful. Has been service engineer and in charge of shop and laboratory.

0301. A graduate of the Texknowlgic College (Russia) seeks a position as first-class draftsman or parts inspector with an automobile factory or automobile accessory concern in the Middle West.

0302. Electrical and mechanical engineer, 33 years of age, 12 years' experience, desires to make connection with some firm as electrical or mechanical engineer or superintendent. Also has selling experience.



Best for Commercial Service

The logical solution of the problem of supporting load and transmitting power. The solid member carries the load—the live axle transmits the power. There is no carrying strain on the jack shaft—no movement of power through the supporting axle.

Write for full details.

TORBENSEN GEAR & AXLE CO.,

216-224 High Street **NEWARK, N. J.**

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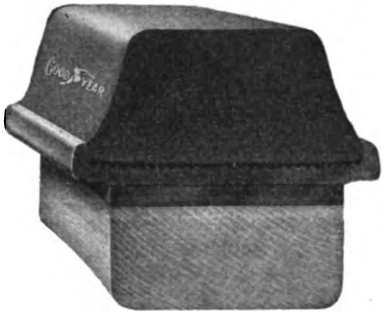
The Trend of the Times

In Truck Tires is Toward the "Pressed-on" Type



The 1915 Goodyear S-V Truck Tire

is a distinct advance over anything yet brought out. A "pressed-on" tire, applied directly to the S. A. E. wheel.

Simplicity—No flanges—No bolts—No wedges—No intermediate bands.

Light weight—Elimination of steel fastenings reduces unsprung weight—as much as 394 pounds on a 5-ton chassis.

Reliability—Absolute security in the "pressed-on" method of attachment.

Long mileage—More high-grade rubber. Technically correct design. Largest proportion of tread rubber available for wear

These improvements combined give tire equipment which will operate at a lower cost-per-tire-mile, than any yet brought out. This we have established beyond the question of a doubt by collecting cost data from 2100 S-V tires in actual service.

GOODYEAR AKRON, OHIO
S-V Truck Tires

Investigate, and you will find the Goodyear S-V truck tire absolutely the best on the market.

THE GOODYEAR TIRE & RUBBER CO., Akron, Ohio
Makers of Goodyear Automobile Tires

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FILL OUT AND SEND TO S. A. E. OFFICE

SECRETARY,

SOCIETY OF AUTOMOBILE ENGINEERS,
1790 BROADWAY, NEW YORK CITY.
Please send application blank to

.....
NAME

.....
POSITION AND COMPANY

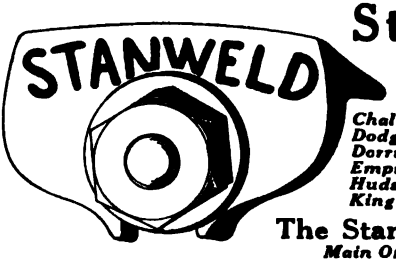
.....
ADDRESS

whom I consider eligible to S. A. E. membership.

.....
S. A. E. MEMBER

.....
ADDRESS

Date.....



Stanweld Rim

No. 20—Equipment on these cars

Chalmers	*Kissel*	*Pathfinder*
Dodge	*Lewis*	*Pearless*
Dorris	*Mitchell*	*Pilot*
Empire	*Moon*	*Reo*
Hudson	*Overland*	*Richmond*
King	*Stearns (light four)*	*Westcott*

The Standard Welding Company
Main Office and Factory: CLEVELAND
NEW YORK CHICAGO DETROIT

HANS RENOLD DRIVING CHAINS

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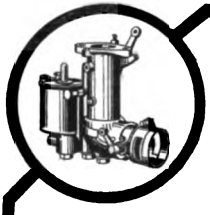

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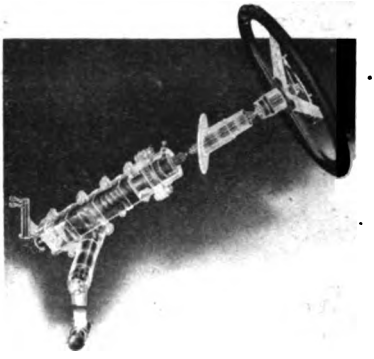

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A hundred and ninety thousand automobile owners in their day after day driving are realizing the soundness of Delco engineering principles and the sterling quality of Delco manufacturing practice.

The Delco System was the pioneer in the electric cranking, lighting and ignition field.

And from the time the first electrically cranked car appeared Delco leadership has never been questioned.

You willl find the Delco System at the Automobile Shows as regular equipment on the

Cadillac	Hudson	Cole	Cartercar
Buick	Oldsmobile	Auburn	Jackson
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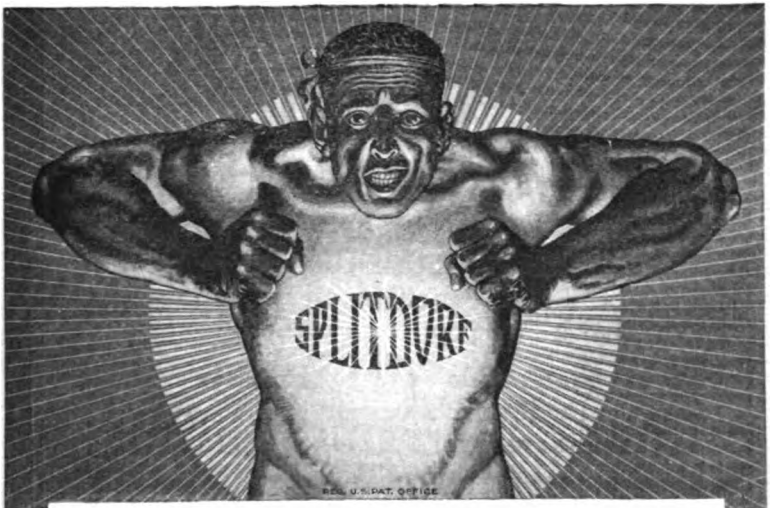

The "EU4-2" is a new addition to the rapidly increasing Splitdorf high tension family, and is in reality a big brother to the "EU-4," being more powerful, with its double magneto, and designed for four-cylinder motors developing as high as 40 horse power.

The principal dimensions of the "EU4-2" magneto as regard centres, spacing of holding down bolts, bolt hole diameters and threads and taper shaft dimensions agree exactly with the standard adopted by the S. A. E. and it will fit any regular motor now manufactured. Regular couplings furnished as standard equipment with such motors will fit without alteration.

The quantity and quality of spark necessary for the complete ignition of the lowest grade fuels marketed is assured at all times—the punch is always there to fire at the highest and lowest motor speeds.

One overwhelming feature which contributes so much to the success of the "EU4-2" magneto is that it enables the motor to run on high gear at as low a speed as on a battery in the best of condition.

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Manufacturers of motor oils have been in the habit of saying that their oil is "carbon free" —or that it "will not form carbon."

These statements are manifestly absurd. Every oil will form a carbon deposit under certain conditions, and the carbon will vary, both in quality and in quantity.

We have never said that Texaco Motor Oil will not deposit carbon, but we MAINTAIN that when carbon IS formed, it is of an insignificant amount and is of a soft, spongy nature.

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We will be glad to supply you with further information.

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The Standard Wheels For American Cars and Trucks

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Stronger—Safer—More Economical. That's a combination that can't be beaten.

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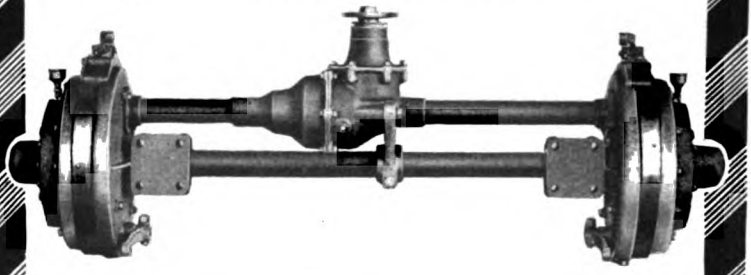
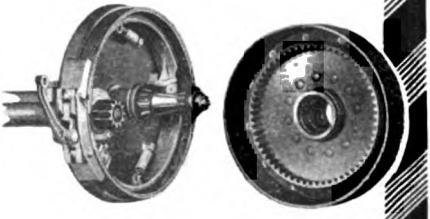
Russel

Internal Gear Drive Axle for One Ton Truck



FOR over a year our Engineering Department has concentrated its entire attention on the development of the one ton truck axle. Our investigations and tests have shown us the strength and weakness of the various rear drive systems now in use. The logical result has been the development of the one ton axle announced herein. We believe it represents the most serviceable compromise between the conflicting demands of durability, efficiency, quietness, simplicity, neatness and cost.



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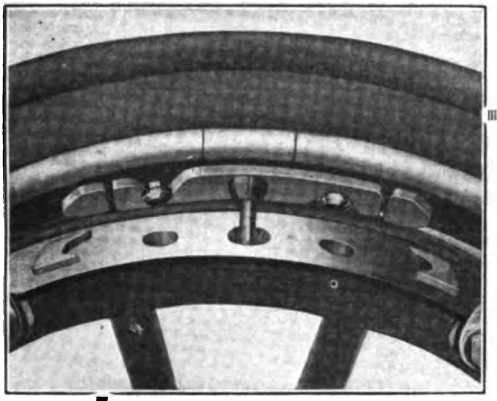

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The Rim that is Conclusively Mechanical

The arrow and "V"-block driving construction makes the Detroit Rim absolutely positive, and is the only demountable rim having this unique feature.

The cutout section of the Detroit Rim allows such freedom of operation in removing the tire that a pair of ordinary hands are the only tools—in extreme cases a small screw-driver is all that is necessary.

We claim for the Detroit Rim: strength, lightness, quality, economy and durability—a rim any novice can operate without the assistance of the "nearest garage."

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Jackson Rim Company

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Exclusive Manufacturers of the Detroit Demountable Rim

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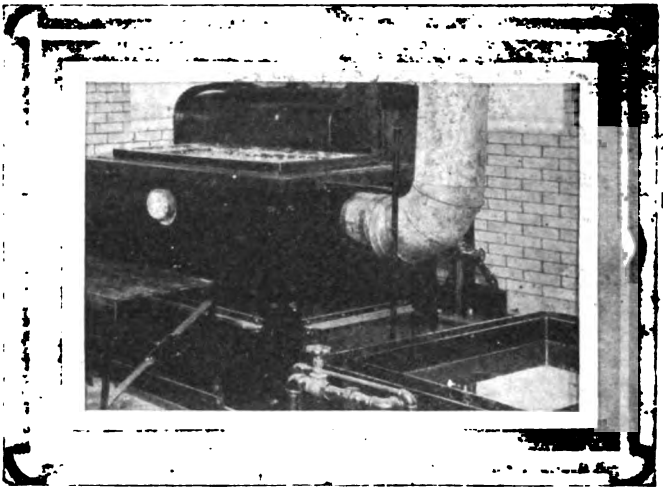

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ELIMINATES MISTAKES

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VOL. VII NO. 4

S·A·E BULLETIN

JAN 1915

PRESIDENTIAL ADDRESS

STANDARDS COMMITTEE MEETING

DISPOSITION OF STANDARDS RECOMMENDATIONS

NEW STANDARDS ADOPTED

ROD AND YOKE END PINS

GROUND-RETURN INSTALLATIONS

SOCIETY OF AUTOMOBILE ENGINEERS
1790 BROADWAY, NEW YORK

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SAE BULLETIN

VOL. VII JANUARY, 1915 No. 4

Published by the Society of Automobile Engineers
1790 Broadway, New York

WILLIAM H. VAN DERVOORT, President. COKER F. CLARKSON, Secretary.
ARTHUR B. CUMNER, Treasurer.

Issued monthly, 50 cents a number, $5.00 a year; to members 25 cents a number, $2.50 a year. Entered as second-class matter, August 27, 1914, at the post office at New York, New York, under the Act of August 24, 1912.

PRESIDENTIAL ADDRESS OF HENRY M. LELAND

We again most cordially greet our members of the Society of Automobile Engineers.

The closing year, like most of its predecessors, has been notable for the marked advancement that has crowned the efforts of our profession. Our labors still give us the whole-souled satisfaction of successful creative achievement, and rejoicing with us are thousands upon thousands who find employment in producing our creations, while other thousands who purchase the finished product find their pleasure and profit multiplied thereby. In no other field has the ripe harvest so quickly followed the cultivation of fallow ground.

During the last fiscal year 306 were added to our membership. Our growth year by year is indicated by the total membership at the end of fiscal years, as follows:

1912	1,252
1913	1,611
1914	1,804

There has been a loss of 113 members during the past year. I regret to learn that many of these members stepped

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out because of financial embarrassment due to the widespread business depression. Very strangly, too, some members have left us because of inability to appreciate the great work the Society has done for them and for the craft in general. You who have followed the work of the Society as seen in the Transactions, Bulletins and meetings must have been impressed with the great volume of time and study which the faithful workers and various committeemen have given to render us such helpful and far-reaching assistance. I urge as strongly as possible the importance of the co-operation of all members toward a more general exchange of ideas, both in the preparation of papers and in the discussion of the endless variety of subjects considered at our meetings. The final stage has not been attained. The industry is developing. Many questions which we would ask of each other to promote the common welfare are constantly arising.

The importance of our industry grows upon us when we remember that it is but fifteen short years since it really first claimed the attention of the American people. Perhaps no other industry ever attained in so few years the same magnitude. It already rivals in importance the great American railway system in the huge amount of capital required to provide the enormous quantities of material and labor, as well as in the number of men employed, directly or indirectly. When we consider the vast number of motor vehicles produced annually in the United States—the pleasure cars of all kinds and types, the town cars which have become a daily necessity, the great variety of commercial cars for the transportation of materials of every name and nature, and, we add with great sorrow, the increasing application of these effective vehicles for the various needs of a great and cruel war, in which they are proving to be of extraordinary efficiency—we are overwhelmed with the thought of the magnitude of the industrial collosus that has been developed in less than a score of years. Our industry, which is producing hundreds of thousands of motor-driven vehicles, demands annually an amount of material and labor the sum of which is incomprehensible, except to one who has studied it minutely. The number of employes required to produce all the material used directly for the cars themselves, plus the endless variety and amount of the auxiliary devices and accessories, is a vast army almost beyond computation or even imagination, and rivaling that in any other industry regardless of age.

With this inadequate and incomplete picture of the magnitude of the industry before us, is it not, may I ask, in

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the days of its childhood worthy of our best and most patient endeavor? Remembering the mistakes of others, shall we not train it in the way it should grow? I urge that every member determine here and now that he will do his part in the improvement and development of this engineering organization which is charged with the herculean task of developing and standardizing this vast industry. Let me say again, many of our members have done royal and heroic work along these lines. They have been patient in the conferences and discussions, and sacrificed their time, their leisure, their pleasure and their means. For all of this we thank them most heartily. We do appreciate their work.

The Standards Committee has been indefatigable in its work, the results have been far-reaching, and the effects are being felt more and more in the entire industry. The benefits would be more far-reaching and more quickly attained if the managers and other executives of the different manufacturing plants would acquaint themselves more thoroughly with the work of the committee, and more readily consider, and adopt when practical, its recommendations. By so doing very large benefits would be realized by us and by those who purchase our cars.

Recently a new form of membership in the Society has been authorized, namely, departmental membership, the provision in the Constitution being as follows:

> C-12. A departmental member shall be a department, bureau or office of a National, State, County or Municipal government interested in the object of the Society.

Not only can Municipal authorities co-operate in our work, but the State and Federal Governments should work with us, looking toward the standardization of the various types of vehicles in order that they may be readily adaptable and effective for the use of the army. The army engineers should make most valuable and important suggestions as to control system standards, standard methods of securing bodies to chassis and standardization of the chassis so far as receiving special bodies is concerned. In various ways more complete standardization can be brought about to facilitate handling cars in the great vicissitudes of war and the wider field of commercial work.

In my address at Cape May last June I referred to the greater co-operation and the closer relationship existing between the engineering societies and the governments of both Germany and Great Britain than we enjoy in this country. In my judgment, this is a matter of importance to not only

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our engineering societies but our government, and I trust that the membership will become informed upon and lose no opportunity to advance this thought, bringing about a closer relationship, a greater sympathy and co-operation between the various departments or divisons of the government and the various engineering societies.

As showing how our organization appears to the impartial eye of our British cousins, I refer to an article which appeared recently in the *Automotor Journal* (one of the leading English periodicals) and was reprinted, in part, in the November BULLETIN. I hope we may seriously endeavor to make real the picture of us painted by our friends across the Atlantic.

It is said in the good book that "young men shall dream dreams, and old men see visions." May I tell you generally of my vision in regard to the future of the automobile industry? I saw the self-propelled vehicles increase in number and utility until they covered the face of the earth. They took a wider and more important part in the transportation of people, as well as all manner of goods and merchandise; not that they superseded the locomotive and the steamboat, but carried the mighty volume of traffic to and from these transportation giants, which had still to be depended upon for the long haul.

The other part of my vision is not so pleasant to contemplate. I saw that the number of manufacturers of automobiles had about reached its maximum and would constantly decrease until but a comparatively few immense plants would supply the entire world with motor-driven vehicles of every type and nature.

Dreams do not always come true. But if this dream were to become real, and there is always that possibility, what would be the message to our large membership of automobile engineers and to the countless numbers of embryo automobile engineers who are now coming through the colleges? The answer is plain. Every one of the one hundred and thirty or more American automobile plants has its own corps of engineers. Some need more than others. Should these plants become materially less in number, a substantially less number of automobile engineers will be required as designers. What will those engineers do who are displaced as one after another of these plants is diverted to some other industry? To suggest, if I can, a solution of this possibly vital question I inject at this time what I hope none of you will consider merely a pessimistic outburst. I can see two great opportunities for the engineers who will

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be thus liberated from automobile designing, should my prophecy become history.

First. The converted plants will be re-equipped and operated effectively to supply the constantly growing demand for other necessities. New devices must be brought into existence to keep pace with and supply the need for all the material things which are constantly increasing and which our continuously refining civilization demands, not only for daily wants and material needs, but the other uncountable means to satisfy the ever-growing desire for culture and refinement. Supplying this demand will mean increased enlargement of our miscellaneous industries and call for men of your engineering skill, experience and training. It only remains for the automobile engineer to prepare and qualify himself for this enlarged field of opportunity.

Second. Most of the automobile engineers of the future who will remain in the automobile industry with the few large plants, will apply their training and ability to scientific automobile manufacturing rather than to scientific automobile designing. Here is the great opportunity of the future for the automobile engineer. May I outline my conception of the characteristics of such an automobile plant as will stand the stress of time, and of the manufacturing opportunity in such a plant for the automobile engineer? The automobile plant will have the proper combination of capital and brains, correlated to the right ideals and standards. It will produce such a car in design, quality, efficiency and price as will insure a large volume of business. The requisite conditions cannot continue permanently without plenty of capital and a large volume of business. The manager of the plant will be one who is in hearty accord with the high ideals which must be realized in order to establish a permanent and successful business of the kind and magnitude in question.

There are two magic words which you have heard before, and which are the most potent that can possibly be used to express the essentials of success in the manufacture of automobiles on a large, permanent and successful basis. I hasten to take you into my confidence and tell you that these two words are "Knowing How." There is no substitute for these two words—nothing else can take their place.

Shall I explain more fully what results when these two words become animated and dominate the plant? A plant with suitable buildings designed to enable each and every department to be housed and managed in the most advantageous way according to modern experience. The cars to be manufactured will be designed with the most thorough

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attention to every detail to fulfill the purpose in view of the manufacturer. More attention than usual will be exercised to secure a design that will perform its functions adequately, and at the same time can be manufactured advantageously. The latter is important and seemingly frequently *ignored* by the engineer.

The very best and most efficient machinery and equipment available will be secured for every department in the plant. This is of great importance; and right here is where the magic words "knowing how" are potent. No amount of organizing, no amount of driving, no experience or skill can overcome the handicap of a plant provided with inferior or mediocre equipment. The most experienced and successful men will be employed to see that all the small tools, fixtures and appliances are in accordance with the very highest state of the current art.

Each machine will be operated wisely, and every step in the entire plant conducted in the most advantageous manner. Here again there is no substitute for "knowing how." The man who can accomplish this is the most valuable kind of an automobile engineer. He must get the greatest speed, the fastest feed and the fewest cuts consistent with maintaining standards. Let me tell you confidentially that the men who can be depended on to see that these things are done are perhaps not as scarce as living ex-presidents of the United States, yet you can wager safely that their name is not legion.

Of course, it is possible to mention here only a few characteristics. My aim is merely to indicate to members of the S. A. E. what a fertile field is developing for those who will make themselves competent in the manufacturing realm and can say to the world "I know how." The man who can say this will before he reaches the goal have sacrificed much leisure, much pleasure, much rest, and suffered more or less isolation from his friends and society; but he who really attains it will have found the "philosopher's stone" and won a prize worth more in dollars and in satisfaction than to have been born of princely ancestry. If there is a higher business aim of any kind or a more inviting one than to become master of the great art of being a leader (not a follower) in the pioneer work in such a manufacturing plant as is here described, I do not know what it is. If there is a more important or useful calling, I would like to know what it is.

The man who creates things and makes it possible for his fellows to enjoy something useful and wholesome, selecting so wisely the things that he puts into their homes and

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lives bring only pleasure, joy and happiness, with no detrimental alloy, is indeed a benefactor. I cannot conceive how such a one can be other than happy and find *joy* in his *work*.

I wish to thank the members of the Society for their uniform kindness and courtesy toward me when they must have realized how far short of what it ought to have been has been my record as President. I thank especially the members of the Council, the members of the various committees, and the Vice-presidents who have responded to every request to assume duty.

In conclusion, I repeat my former words to you:

From the vantage point of my years and experience may I suggest to you, new engineers of a new industry, that in the whole realm of engineering there is no problem so worthy of your skill and ingenuity and no need so pressing as that of producing men, not things. No task is so complex, and no reward as great, as that which comes to the man who successfully engineers his own life to a higher type of character. In the laboratory of daily life, with the mind, the heart and the conscience as tools, we should, as engineers of the greatest things, convert our baser tendencies and impulses into the noblest realities. To every man who has a real earnest desire to make the most of himself, and to fill to the full the most important niche to which he may aspire in this world and the next, there is a free course and a fair field.

It is great to be an engineer. It is greater to be a man—a great, broad, full-measured man. This is the great calling; the great engineering feat. He who would attain it must, in all life's great problems, in his dealings with his fellows, in his treatment of those beneath him in rank, in his treatment of the weak and unfortunate, in his walks with his equals and superiors, cultivate the personal qualities of justice and mercy, fair play and courtesy. May I express the hope that you, whose genius and application have in so short a time snatched from chaos the wonderful automobile industry, will give to the industry such an indelible stamp of personal integrity and character, that it will stand forever as a type of the highest and best, as it is now the newest?

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STANDARDS COMMITTEE MEETING

On January 5th the Standards Committee held a two-session meeting at the rooms of the Society for the purpose of considering reports of its Divisions, as approved by or subject to the approval of the Council; as well as other old and new business scheduled for presentation to it. William G. Wall and K. W. Zimmerschied, Vice-presidents of the Society, presided at the meeting. Among the members of the Committee present were:

Raymond M. Anderson
V. G. Apple
J. R. C. Armstrong
B. B. Bachman
Joseph Bijur
William Lord Bliss
C. C. Carlton
E. P. Chalfant
Coker F. Clarkson
Charles Ethan Davis
A. H. Ehle
E. H. Ehrman
E. S. Foljambe
Bruce Ford
George F. Fuller
Frank M. Germane
B. D. Gray
Edwin R. Hall
John H. Hertner
Russell Huff
Franz J. Jarosch
Wm. P. Kennedy
Ralph R. Lapointe
Robt. McA. Lloyd
Marcus T. Lothrop
William V. Lowe
C. W. McKinley
Alden L. McMurtry
R. L. Morgan
Walter M. Newkirk
George L. Norris
Wm. T. Norton, Jr.
Harry G. Osburn
William H. Palmer
J. G. Perrin
F. F. Phillips
Niran Bates Pope
E. J. Ross
Charles L. Schwarz
Arthur J. Slade
C. W. Spicer
C. W. Stiger
Wm. R. Strickland
Thomas Towne
John G. Utz
William Guy Wall
E. R. Whitney
C. B. Whittelsey
Frank Allen Whitten
M. W. H. Wilson
K. W. Zimmerschied

The following other members of the Society were also present:

Reuben Allerton
Warren J. Belcher
John Bell
A. C. Bergmann
John R. Cautley
A. Ludlow Clayden

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Arthur B. Cumner
Willis H. Diefendorf
Kingston Forbes
Radclyffe Furness
Frederic W. Galbraith, Jr.
Duncan C. Hooker
C. H. Humphreys
Ferdinand Jehle
John J. Jennings
Henry M. Leland
C. E. L. Lipman
Morris R. Machol
George L. Markland, Jr.
Walter H. Miller
George L. Moskovics
Julius Rosenfield
J. Edward Schipper
Conrad H. Young

ELECTRICAL EQUIPMENT DIVISION

The specific recommendations of the sixth report of the Electrical Equipment Division, printed on page 220 of this BULLETIN, were approved for submission to the Society. The practices recommended in the report refer to "additional" electrical appliances and ground-return installations (one-wire systems). It will be recalled that the Standards Committee approved at its November meeting the recommendation of the Division as to bulb nomenclature.

FRAME SECTIONS DIVISION

The fourth report of the Frame Sections Division (see page 224 of this BULLETIN) was approved, it being understood that it should be considered as covering present development and that additions to or changes in the recommendations would be made as new developments should dictate. The report, as printed at the time of the Standards Committee meeting, was amended to include a 6½" or 7" drop between top of side rail and front spring bolt, for 6" side rail.

LOCK WASHER DIVISION

The report of the Lock Washer Division, which appears on page 228 of this BULLETIN, was approved for submission to the Society as one of progress.

CARBURETER FITTINGS DIVISION

The fifth report of the Carbureter Fittings Division, printed on page 245 of this BULLETIN, was approved for sub-

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mission to the Society, with the suggestion that further consideration be given the establishment of a dimension from the face of the carbureter flange on the cylinder to the center-line of the carbureter.

ELECTRIC VEHICLE DIVISION

The first report of the Electric Vehicle Division as printed on page 230 of this BULLETIN was approved for submission to the Society as recommended practice.*

MISCELLANEOUS DIVISION

The Miscellaneous Division presented as its fifth report revised recommendations for standard yoke and rod end pins; for pitch of threads above 1½" diameter; and a new standard for flat fan belt widths. As presented to the Society, the report included the new spark plug shell standard recommendation which was passed at the November meeting of the Standards Committee. The report (see page 234 of this BULLETIN) was accepted by the Society with the exception of the flat fan belt recommendation, which was referred back to Division for the establishment of plus and minus tolerances.

BALL AND ROLLER BEARINGS DIVISION

A progress report showing a list of suggested standard sizes of roller bearings (see page 233 of this BULLETIN) was submitted by the Ball and Roller Bearings Division. It is the purpose to have this list criticized by manufacturers and users of roller bearings with a view to obtaining data for the establishing of a standard set of sizes. It was stated that a corresponding list for thrust bearings was being prepared.

SPRINGS DIVISION.

The fourth report of the Springs Division (see page 237 of this BULLETIN) contained specific recommendations as to nomenclature of cantilever springs; tests for parallelism of eyes; eye bushing and shackle bolt tolerances; wrapped eyes; width of spring ends; frame brackets; offset of center bolts; nuts for spring clips; center bolts; nuts for center bolts; and spring widths. It was reported that the Division

*Not accepted at the Society Meeting.

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thought it inadvisable to recommend standards for master leaf lengths, beads and slots, and elliptic spring heads. The report closed with a list of matters for the future consideration of the Division. The report was approved for submission to the Society.

IRON AND STEEL DIVISION

In its sixth report the Iron and Steel Division presented some general notes on the nature and use of the data on the physical characteristics of S. A. E. steels under various heat treatments. A supplement to this report, giving the physical characteristics of S. A. E. steels under various treatments, with specific notes as to the use of each, was issued in separate pamphlet form. This part of the report was constituted of revised "Notes and Instructions" on the use of S. A. E. steels, made necessary in part by the reduction in number of and changes in the specifications made at the 1914 semi-annual meeting.

The Division recommended the reduction of the range of chromium in the 61 series of S. A. E. steels to .80 to 1.10 per cent.

The Division further recommended that the silico-manganese steel specification of the Society should be modified to conform to the corresponding specification of the American Society for Testing Materials, and be as follows:

SILICO-MANGANESE STEELS

Specification No. 9250

Carbon	.45%	to	.55%	(.50% desired)
Manganese	.60%	to	.80%	(.70% desired)
Phosphorus, not over	.045*			
Sulphur, not over	.045			
Silicon	1.80%	to	2.10%	(1.95% desired)

Also that the following silico-manganese steel specification of the American Society for Testing Materials should be adopted:

Specification No. 9260

Carbon	.55%	to	.65%	(.60% desired)
Manganese	.50%	to	.70%	(.60% desired)
Phosphorus, not over	.045*			
Sulphur, not over	.045			
Silicon	1.50%	to	1.80%	(1.65% desired)

*Steel made by the acid process may contain maximum 0.05% phosphorus.

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The report* and its supplement were approved for submission to the Society.

STANDARDS EXCHANGE DIVISION.

The Standards Exchange Division has been concentrating on formulating a standard for bell housings over the flywheel. Its first report, presented in the form of a drawing (see page 244 of this BULLETIN), gave dimensions for five types of housings, ranging from a size suitable for large high-power or heavy-duty motors to one for very small motors. The report, the points of which were amplified by the remarks of the chairman of the Division, was approved for submission to the Society.

NOMENCLATURE OF CAR PARTS.

The interim report on nomenclature of car parts set forth the results of an investigation as to the present variation in the use of terms and a proposed method of advancing the desired simplification in this connection. The purpose is to divide the car into groups or assemblies, the parts in each group to be given proper names by representatives of manufacturers of the group or part. The report contained the proposed divisions and groupings (see page 248 of this BULLETIN) and was approved as one of progress.

PLEASURE CAR WHEELS DIVISION.

Lists of nine even tire sizes and nine corresponding oversizes comprise the third report of the Pleasure Car Wheels Division. The even tire sizes are for the use of the manufacturer as initial equipment, the oversizes being reserved for the use of the car owner, to take care of additional weight he may place on his car. The report is substantially the same as that previously presented to the Standards Committee, with the addition of the 36" x 5" tire. The report as printed on page 247 of this BULLETIN was approved for submission to the Society.

There was brought out in the meeting the fact that there is great lack of interchangeability in American and Euro-

* The curves, with corresponding tables of physical properties of S. A. E. steels, will be printed in a later BULLETIN.

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pean standards for the mounting of pneumatic as well as solid tires. President Leland pointed out that the actual differences in tread diameter of pneumatic tires of American make, of the same nominal tread diameter, are so great as to affect speedometer readings greatly. He submitted a large amount of data for consideration in this connection.

STANDARD TOOTH FORMS FOR SILENT CHAINS

As new business the Standards Committee took up the question of the feasibility of standardizing the tooth form of sprockets for silent chains. The advantages such a standard would bring are obvious; making possible interchanging chains of different make. All of the chain makers had been requested to send representatives to the meeting, and some of them did so. It is clear that the subject would have to be approached with a number of structural features of chains in view. It was the sense of the meeting that a committee should be appointed to take up the subject.

DISPOSITION OF STANDARDS COMMITTEE REPORTS AT THE ANNUAL MEETING OF THE SOCIETY

ELECTRICAL EQUIPMENT DIVISION

The sixth report of the Electrical Equipment Division, printed on page 220 of this BULLETIN, was adopted.

FRAME SECTIONS DIVISION

The fourth report of the Frame Sections Division, which appears on page 224 of this BULLETIN, was adopted.

CARBURETER FITTINGS DIVISION

The fifth report of the Carbureter Fittings Division, as printed on page 245 of this BULLETIN, was adopted.

ELECTRIC VEHICLE DIVISION

The first report of the Electric Vehicle Division (see page 230 of this BULLETIN) was referred back to the Division.

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MISCELLANEOUS DIVISION

The fifth report of the Miscellaneous Division, as printed on page 234 of this BULLETIN, was accepted. A portion of the report relating to flat fan belt widths was referred back to the Division for the establishment of tolerances.

SPRINGS DIVISION

The fourth report of the Springs Division, as printed on page 237 of this BULLETIN, was read before the Society, but no action on it was taken, owing to insufficient attendance at the session in question.

IRON AND STEEL DIVISION

The sixth report* of the Iron and Steel Division, with its supplement, was adopted.

STANDARDS EXCHANGE DIVISION

The first report of the Standards Exchange Division, presented in the form of a drawing, printed on page 244 of this BULLETIN, was adopted.

NOMENCLATURE OF CAR PARTS

The interim report on nomenclature presented by the office of the Society, as printed on page 248 of this BULLETIN, was accepted.

PLEASURE CAR WHEELS DIVISION

The third report of the Pleasure Car Wheels Division (see page 247 of this BULLETIN) was adopted.

COMMERCIAL CAR WHEELS DIVISION

The recommendation of the Commercial Car Wheels Division, as approved at the November meeting of the Standards Committee, that the felloe band thickness for four-inch single solid motor tires be increased from 1/4" to 3/8", was adopted.

*The report and supplement will be printed later in the Bulletin.

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RESEARCH DIVISION

The Research Division made a progress report on the determination of an engineering formula for vehicle taxation. Since making its report in November (see December BULLETIN, page 191), it has been learned that the United States Government is conducting experiments on road destruction, the results of which will prove of the greatest value in developing the formula. The report was accepted. For complete text of the report as presented this month, see page 228 of this BULLETIN.

1915 SUMMER MEETING

The Council has canvassed the members with a view to learning their wishes as to the time and place of the 1915 summer meeting. The returns received by mail, as announced at the annual meeting of the Society held this month, were:

Time.		Place.	
June	140	San Francisco	32
July	72	Great Lakes steamer	248
August	62	City on Great Lakes	112
September	21		
No specific date	144		

The Society is apparently strongly in favor of the Summer Meeting being held in June on a steamer cruising the Great Lakes.

The Council announces that a trip of about four days on a steamer even better suited to the members' needs than the one chartered in 1913, is in prospect. A statement of exact dates, the itinerary, rates and other details will be given in due course.

From the present outlook it appears that it will be well for the members to be planning on starting on a very delightful and instructive cruise from Detroit and return about the middle of June.

PRESENTATION TO HENRY SOUTHER

One of the most interesting features of the Annual Meeting was the presentation by his associates on the Standards Committee and other friends in the society to Henry Souther, retiring chairman of the committee, of a token of the admiration and affection in which he is held. The presentation took the form of a silver piece suitably engraved. It was also announced that Mr. Souther had been made a life mem-

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ber of the society in recognition of his distinguished achievement in the orderly development of the art of automobile engineering.

In relinquishing the chairmanship, owing to the press of other duties, Mr. Souther stated forcefully that the work of standardization has only begun. He made clear the necessity of the executives of car manufacturing companies, as distinguished from the engineers of the same, becoming familiar enough with the S. A. E. standards to appreciate the great wisdom of putting them into full effect in design and production, for reasons of reduced cost with equal or better quality, and of marked benefit to service departments and car users.

SIXTH REPORT OF ELECTRICAL EQUIPMENT DIVISION
(AS ACCEPTED)
GLARING HEAD-LIGHTS

The Division has received from its sub-committee an interim report submitting data as to ordinances in force and head-light dimming devices approved by various municipalities. The Division feels, however, that no specific recommendation should be made by it at this time as to a definition of glaring light. The Division has decided to enlarge its sub-committee on this subject, and requested that it co-operate in the formulation of recommendations or definitions with the Illuminating Engineering Society and similar societies. It is expected that this sub-committee will investigate the subject in a thorough manner, reporting further after research and possibly special tests.

The said sub-committee consists of

R. J. Nightingale, Chairman
Leonard Kebler
Alden L. McMurtry
W. L. Bliss
W. H. Conant

LAMP BRACKET DIMENSIONS

The Division is of the opinion that inasmuch as the type of head-light bracket generally used is likely to be changed, no recommendation as to standard center to center distance of the conventional type fork bracket is necessary at this time.

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ADDITIONAL ELECTRICAL APPLIANCES

Before any electric appliance is added to a gasoline car, after it is sent out from the car manufacturer's plant, a description of the said appliance should be submitted to the car manufacturer as to suitability for and the best method of application to the car.

BULB BASES, SOCKETS AND CONNECTOR PLUGS

The sub-committee on bulb bases, sockets and connector plugs has recommended that an additional drawing with dimensions showing details of the connector plug be added to the S. A. E. data sheets. Also an end view of the socket, showing the exact location of the bayonet lock slot and detail dimensions of same.

The sub-committee has further recommended that bulb bases and connector plugs be made to interchange in the same sockets.

The sub-committee expects to submit at the next meeting of the Standards Committee blue prints incorporating all of above recommendations.

The sub-committee was asked to submit information on the design of bulb bases to interchange for "one" or "two" wire systems.

GROUND-RETURN INSTALLATIONS

Nomenclature

It is recommended that the systems of installation commonly known as "two-wire" and "single-wire" systems be termed respectively "insulated return" and "ground-return" systems.

Any installation in which (apart from ignition) the chassis frame or bare metal is used as part of the return circuit, shall be considered as a "ground-return" system.

Use of Conduit

Insulated conductors must be protected by metallic or non-metallic conduit outside of the insulation, except where otherwise protected from the elements, or where out of contact with metal surfaces. Such locations are inside of the body or on wooden dash and instrument boards, or extending in a straight line between chassis and lamps.

The preferred conduit for insulated conductors is a metal tube, either rigid metal or flexible metallic conduit. Where metallic conduit is not used the wires may be run in non-metallic conduit.

Where conductors are run through flexible metal conduit, the latter must be provided at any open end where wires project, with ferrules having rounded edges.

The fit between the conductor and the ferrule should be sufficiently tight to exclude the free entry of water and oil.

The ends of all conduit where exposed to weather must point downward, so that water will run out of, instead of into, the conduit.

Where metal conduit is led to a connector it must be securely soldered, or permanently clamped to the plug, either inside or outside of a sleeve not less than ¼" long.

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Where wires are not protected with conduit they are to be cleated at intervals not exceeding 10 inches. Such cleats may be of metal with a layer of insulation interposed between the cleats and wire.

Clearance

When on wooden dashboard conduit is omitted, no wire shall be nearer to the exhaust pipe than 2 inches.

Where conduit is used the minimum clearance between the exhaust pipe and the conduit shall be 1½ inches.

A minimum clearance of ¼ inch shall be securely maintained between conduit and the nearest carbureter, gasoline pipe, gasoline tank, moving rod and moving lever.

Grounding

Wherever an insulated conductor is connected to "ground," the connection shall be installed so as to be readily accessible and removable on the completed car.

When the frame of the car is relied on as the ground return, connections shall be made to the chassis frame, or to a substantial part firmly attached to the frame at two or more places, i.e. connections must be to chassis parts in contradistinction to body parts.

Conductors shall not be attached to the frame except by means of terminals soldered to them. The surface on which the terminals are fastened must be clean and free from oxide or paint. The terminals must be fastened to the frame by means of screws or bolts.

Starting circuits should be run independent of "ground" unless a substantial switch is placed in the "ground" connection circuit in an accessible place. The storage battery should be "grounded" on the positive side, and by only one conductor. This "ground" connection should be made in an accessible place by not more than a single screw or nut, or shall be made readily detachable by means of an accessible switch.

Starting Cable

If starting cable is connected to the frame the connection should be effected in a thorough manner, preferably by riveting a suitable brass or copper plate to the frame, which should be first thoroughly scraped; soldering as well as riveting being recommended. The cable in turn should be sweated to a suitable terminal lug which is then clamped or bolted to said plate.

All "grounds" should be installed so as to be readily accessible and removable on the completed car.

Apparatus intentionally "grounded" in itself shall be so made that for inspection or test the "ground" can be opened without dismantling the apparatus.

Connectors

All connectors shall be so made that when disconnected the section which is alive will have all live parts recessed 1/16" or more below the end of the shell of the connector.

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Springs used in connectors shall not be relied on to carry current.

Protection Against Accidental Short-Circuits

All connecting posts on fuse and junction blocks, or on instruments, generators, motors and switches which must necessarily have exposed live parts, shall be so constructed, recessed or installed that an accidental short-circuit cannot be effected with screw-drivers, pliers, wrenches or other tools used while making minor repairs or adjustments.

Where live parts might be liable to accidental short-circuits to adjacent metal, they must be provided with suitable insulating caps or bushings, or surrounded with a suitable insulating barrier; or the adjacent bare metal liable to be accidentally connected to them through repair tools, should be covered with insulating material.

Protective Devices

No protective device need be installed in the starting circuit.

The current to all lighting and signal circuits shall be passed through protective devices.

Protective devices should be on the battery side of switches and junction boxes.

When fuses are used the circuits shall be so arranged that the blowing of a single fuse shall not extinguish all the driving lights, or prevent an inspection lamp being connected to a live circuit.

Fuses must be of the enclosed type, constructed so that inspection can show whether or not they have been melted.

Fuses should be marked with their rating.

Standard fuses shall be 1¼" long overall, with ferrules ¼" in diameter; or 1½" long overall, with ferrules 13/32" in diameter.

It is recommended that fuses of the following ratings be used:

10 ampere
20 "
30 "

Fuses must be so constructed that with the surrounding atmosphere at a temperature of 75° F. (24° C.) they will carry indefinitely a current 10 per cent. greater than that at which they are rated, and at a current 25 per cent. greater than the rating, open the circuit without reaching a temperature which will injure the fuse tube or terminals of the fuse block. With a current 50 per cent. greater than the rating and at room temperature of 75° F. (24° C.) the fuses starting cold must blow within one minute.

The temperature of the exterior of the fuse enclosure must not rise more than 125° F. (70° C.) above that of the surrounding air when the fuse is carrying the current for which it is rated.

Fuse clips must be so made that fuses cannot slip out accidentally. They must be fastened to a base so that they cannot turn.

Clips should be so designed and protected that they cannot be sprung together enough to take a permanent set interfering with the insertion of the fuse, or so that they can be sprung apart far

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enough to give them a permanent set sufficient to prevent their holding the fuse tightly.

Battery

The battery must be installed so that neither acid fumes nor overflow of water or electrolyte will cause serious leakage of current.

Battery hold-down bolts, if connected to metal handles or other metal parts at the level of the top of the jars, must be insulated at at least one of their two ends.

Bulb Sockets

Bulb sockets must be so made that the continuity of the return path for current is not impaired when the lamp is subjected to vibration.

In lamps, hinges shall not be relied on to carry current between the bulb socket and the battery. The train of connections must either be permanent or so spring-held that contact is maintained tight under vibration.

Bulb Nomenclature

It is recommended that the Society designate by the word "bulb" the detachable electric light-giving unit comprising the filament and its glass envelope; and designate by the word "lamp" the fixture for mounting and utilizing the light of the bulb.

Respectfully submitted.

ELECTRICAL EQUIPMENT DIVISION,

A. L. RIKER,

Chairman.

FOURTH REPORT OF THE FRAME SECTIONS DIVISION

(AS ACCEPTED)

The following proportions and specifications are submitted for consideration as recommended practice in frame construction. These figures were arrived at through correspondence and conversation with various people interested. The Division is indebted to L. R. Smith for a great deal of practical suggestion for various frame proportions. In many instances the figures represent standard practice at the present time, but in some cases the figures are composite. For instance, a man who is now using a side rail having a front-end curve of 13 9/16" radius could probably use a 12" or 16" radius just as well in designing such a frame over again or a new frame.

The figures in this report are, to a certain extent, of empiric rather

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than scientific derivation. The frame is a part of the car into which the element of shock enters so largely as to destroy any mathematical data regarding any theoretical proportions and cannot be figured the way a bridge would be constructed, even though it may act as a bridge when the car is standing on the floor. The attempt to proportion the cross-section of the frame to either horsepower rating of engine, wheelbase of car or number of passengers carried, would be impracticable for best results, although there is a slight relation between the wheelbase and depth of side rail section, and the strength of certain sections may be increased by gage of metal for different conditions.

The following recommended practice is suggested for acceptance:

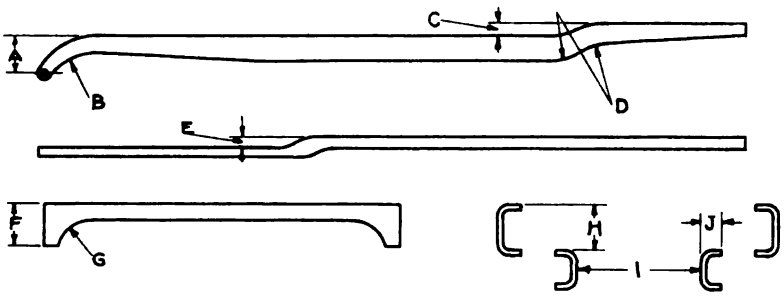

Fig. 1

A—Amount of drop between top of side rail and front spring bolt:

4″	or 4½″	drop for	3″	side rail
4½″	or 5″	drop for	3½″	side rail
5″	or 5½″	drop for	4″	side rail
5½″	or 6″	drop for	4½″	side rail
6″	or 6½″	drop for	5″	side rail
6½″	or 7″	drop for	6″	side rail

B—Represents radius or curve of bottom flange of side rail at front end:

8″, 12″, 16″, 20″ and 24″

C—Rear-end rise—amount of difference between level of frame at rear and top flange of side member:

2″, 3″, 4″ and 5″

D—Radii of combined curve in bottom flange of side member to make rise at C:

10″, 20″ and 30″

E—Side rail offset to commence at least 10″ back of rear end of front end taper.

Cross-Members

F—Recommended widths of gusset plate ends—4″, 5″ and 6″.

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G—Radii of curved gusset plates to be 3" and 4". Straight gusset plates to be cut at angle of 45°.

It is considered impracticable to stipulate recommended practice as to shapes of cross-members, due to different radiator designs, etc. Members with straight drops, however, could be made to have drops vary in multiples of ½", adopting a constant angle for the dropped portion.

H—Top of sub-frame to be on line with inner side of lower flange of side rail.

I—Width between bars for flywheel clearance to be 17", 17½" and 18".

J—Recommended width of all engine bar flanges to be 1½".

Width of Frame

A recommended practice of 30" for front end of frame is submitted, the width in rear to vary with side rail offset.

Practice for Hot Riveting

Diameter of Rivet	Diameter Drilled Hole	Spacing Distance Between Centers
5/16"	11/32"	1½"
⅜"	13/32"	1½"

Several recommendations regarding the side rail sections and material have already been passed upon by the committee. Later practice, however, suggests certain changes and additions. We therefore submit the following revision for approval:

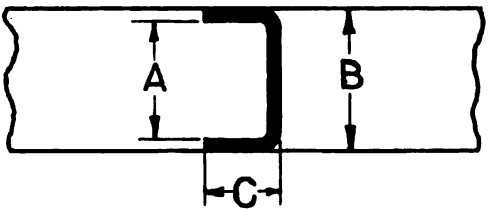

Fig. 2

Designation	C Minimum Flange Width	A Punch Size	B Variable Outside Dimension Using .125	Using .156	Using .187	Using .250
3"	1½"	2¾"	3"	3 1/16"		
3½"	1½"	3¼"	3½"	3 9/16"	3⅝"	
4"	1½"	3 11/16"	3 15/16"	4"	4 1/16"	4 3/16"
4½"	1½"	4⅛"	4⅜"	4 7/16"	4½"	4⅝"
5"	1¾"	4⅝"	4⅞"	4 15/16"	5"	5⅛"
5½"	1¾"	5⅛"	5⅜"	5 7/16"	5½"	5⅝"
6"	1¾"	5⅝"	5⅞"	5 15/16"	6"	6⅛"

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Radius of Fillets

3/16" for sections below 5"
¼" for sections 5" and above

Miscellaneous

Straight center sections of side rails to be designed in multiples of 2". Taper of side rail ends to be 1/16" to 1". This taper, coincident with center sections in multiples of 2", will produce a depth of section at extreme ends of side rails varying in multiples of ⅛".

MATERIAL

Chemical and physical properties recommended as embodying current practice minima:

Chemical		Elastic Limit, Lbs. per Sq. In.	Reduction of Area, per cent	Elongation in 2", per cent
S. A. E. Steel 1020 Carbon Steel (.15–.25 Carbon)	Natural	35,000	45	25
S. A. E. Steel 1025 Carbon Steel (.20–.30 Carbon)	Natural	40,000	45	20
	Heat Treated	60,000	50	20
S. A. E. Steel 3230 Nickel Chromium (.25–.35 Carbon)	Heat Treated	85,000	50	18

Respectfully submitted.

FRAME SECTIONS DIVISION
J. G. PERRIN, *Chairman.*

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PROGRESS REPORT OF THE LOCK WASHER DIVISION

In accord with report submitted by this Division at its last meeting, we have considered the present S. A. E. standard of lock washers and have reached the opinion that it is not necessary to specify further the material from which lock washers should be made, but that it is necessary to impress upon the inspectors and inspecting departments of the various automobile manufacturers, that the tests as outlined by the S. A. E. specifications should be more rigidly made and enforced.

During the past year we have received requests and suggestions that lock washers of given sizes be standardized for use on machine screws. We therefore deem it wise to institute specific sizes of lock washers for use on perhaps Nos. 6, 8, 10, 12 and 14 machine screws.

Before recommending given sections as standard for such screws, we feel that it would be of advantage to obtain from manufacturers of automobile accessories, such as motor starters, lighting equipment and magnetos, in which the greater proportion of small lock washers is required, an idea of the sizes and standards of machine screws used. We would then propose standard lock washers to meet the most important requirements and offer these as addenda to the list now in force.

Respectfully submitted,

LOCK WASHER DIVISION,
C. E. DAVIS, *Acting Chairman.*

DATA ON ABOVE-MENTIONED MACHINE SCREWS

No.	Diam.	Nearest Common Fractions and Decimal Equivalents
6	.138″	$\frac{1}{8}$″ = .1250″ $\frac{9}{64}$″ = .1406″
8	.164″	$\frac{5}{32}$″ = .1562″ $\frac{11}{64}$″ = .1719″
10	.190″	$\frac{3}{16}$″ = .1875″ $\frac{13}{64}$″ = .2031″
12	.216″	$\frac{7}{32}$″ = .2187″ $\frac{15}{64}$″ = .2344″
14	.242″	$\frac{15}{64}$″ = .2344″ $\frac{1}{4}$″ = .2500″

RESEARCH DIVISION REPORT

VEHICLE TAXATION FORMULA

The Research Division begs to submit the following report of progress covering the development of a taxation formula to be applied in connection with vehicles, both motor and horse.

Attention is called to the statement made at the last meeting of

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the Standards Committee as to contemplated action covering the probable make-up of the formula and source of data to be obtained. Since that time the various members have expressed themselves regarding the methods to be pursued in arriving at a legitimate formula and these vary from actual experiments to conclusions drawn from data obtained elsewhere. The consensus of opinion after much discussion is that experimental work will offer many obstacles, chiefly in the form of money necessary to carry them on, and time in which to provide warrantable conclusion. This is accentuated by the fact that the United States Government in one of its departments is at present in the midst of experiments of exactly the nature that will provide exceedingly valuable facts for the investigation in hand. These experiments will not be completed for some months, but word has been received that the results will be gladly furnished the Division as soon as possible after that time.

Coupled with this opportunity is the existence of valuable data belonging to the various state highway commissions and particularly that of Massachusetts. Arrangements are already under way to take up with the head of the Massachusetts Commission, at his earliest convenience, the question under discussion, which will result, it is hoped, in a marked advance in our investigation. The information referred to contains data relative to practically all classes of vehicles, both horse-drawn and motor-driven. The approximate cost of road maintenance per vehicle per mile, has been determined and it now remains to classify the importance of the various types of vehicles regarding their destructive tendencies.

Although much thought has been given to this question of a Taxation Formula, and many arguments have resulted, the committee does not as yet feel willing to assume the responsibility of even a tentative formula. We desire to extend our inquiries still further, and to obtain information which will strengthen our position in the matter. Later a formula together with our reasons for the factors involved, will be submitted to the Standards Committee for discussion and criticism only. When this opportunity arrives it is sincerely hoped that each will give freely of his ideas in the matter, for cooperation on your part will assist materially.

Subsequently to this, the members of the Research Division will take into consideration the points made, and if occasion warrants will incorporate them or their influence in a *final* formula.

For your specific information, we beg to say that the features, the importance of which is being considered, are, in the main, as follows:

A—General Classification (Pleasure or Commercial).
B—Type of Vehicle (Horse or Motor).
C—Total Weight.
D—Capacity (In weight).
E—Weight on Tractive Wheels.

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F—Type of Tire.
G—Size of Wheel.
H—Maximum H.P. of Engine.
I—Speed of vehicle when maximum H.P. is developed (High Gear).
J—Number of Cylinders.
K—Use of Non-skid devices.

All of the above items (and others of minor importance) will be given consideration in the make-up of the formula. By no means, however, does it follow that they will necessarily appear as factors; rather those that do finally appear will be the result of combining the above as to their influence upon each other on the whole.

Respectfully submitted.

RESEARCH DIVISION.

D. L. GALLUP, *Chairman.*

FIRST REPORT OF ELECTRIC VEHICLE DIVISION

(REFERRED BACK AT SOCIETY MEETING)

The Electric Vehicle Division has the following recommendations to offer.

SPEED AND MILEAGE RATINGS

Electric vehicle speed ratings shall be based on continuous operation with one-half load over hard, smooth and level roads or pavements at the actual average battery voltage.

Electric vehicle mileage ratings shall be based on the rated five-hour discharge capacity of the battery and a continuous run with one-half load over hard, smooth and level roads or pavements.

MOTOR VOLTAGE

The Division recommends the adoption of two classes of motors for use upon electric vehicles, one series designed for 80 to 85 volt operation, characteristic curves to be furnished by the manufacturers for each of these two voltages. The second series of motors to be designed for 60 to 66 volt operation, characteristic curves for each of these voltages to be furnished by the manufacturer.

MOTOR NAME-PLATES

It is recommended that each motor shall carry a name-plate setting forth the following particulars:

Manufacturer's name and address
Whether series, shunt or compound automobile motor
Frame size

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Volts
Amperes
R.p.m.

Under volts, amperes and r.p.m. should be given the figures for both high and low limits of voltage as recommended above.

EFFICIENCY TESTS OF SOLID TIRES

The Division recommends for testing the comparative efficiency of solid rubber tires the use of the rebound test method as developed by Mr. E. R. Whitney, a member of the Division, and described as follows:

Tests are to be made with an instrument constructed in accordance with the following:

A steel hammer of cylindrical form 5" x 1 5/64", the lower end formed to a semi-circular shape, is mounted in a brass tube of 1¼" outside diameter and No. 19 B.W.G. (1.166" inside diameter), of a proper length to permit of 100 graduations ¼" apart and marked from 0 to 100, and with the necessary additional length to provide for a stop and a latch at the top to support the hammer at the upper end of the tube. A pointer to be carried by the hammer is to be arranged so as to be at zero with the lower end of the hammer in line with the lower end of the tube and at 100 when held by the latch at the upper position, the latch to be so shaped as to release the hammer uniformly each time. The tube is to be slotted along one side for a part of its length to permit of the pointer extending through freely to the outside of the tube and over the graduations.

In order to prevent air from being confined in the tube as the hammer drops at least 4, ⅜" holes are to be drilled through the tube as close to the lower end as practicable.

The tire efficiency is obtained by observing the highest point reached by the pointer on the rebound of the hammer when dropped from 100. When making tests the instrument is placed on the highest part of the tire and is held in a vertical position. It should not be pressed down on the tire but should rest lightly on it. The tire itself should be held straight and not inclined at an angle. In order to obtain reliable and uniform results the tire must be well supported under its base. When mounted on a wheel in the usual manner the tire should rest on the ground or a solid floor. When making tests before mounting the tire on the wheel, tires that are not of the solid-base type should be mounted in a channel or on a rim or otherwise well supported under the base. All tires should be mounted on a heavy solid support of sufficient weight and rigidity to receive the blow of the hammer without giving away appreciably.

As the efficiency of the tire varies considerably with the temperature, it is important that a definite temperature be adopted and all tests be made at this temperature. Seventy degrees Fahrenheit is recommended, and unless otherwise definitely specified it is to be

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understood that all specifications and tests are based on this temperature. Care should be taken that the temperature of the tire is obtained and not that of the surrounding air, as there is apt to be considerable variation between the two unless the tire has been standing some time in a room of uniform temperature. It also takes some time for the temperature of the tire to become uniform throughout its depth.

As it may be difficult at times to bring the tire to exactly the correct temperature, an allowance can be made for temperatures above and below 70 degrees, but as the allowance to be made varies with different compounds, definite figures cannot be specified that will apply in all cases, but by making a series of tests on various tires at various temperatures, curves may be plotted that will give in a general way the amount of allowance to be made in efficiency due to temperature.

It will be noticed when several readings are taken at the same position on the tire the last reading will be higher than the first. As giving results more nearly in accordance with service conditions, it is recommended that the hammer be allowed to drop several times and then the highest reading taken. The tire should be tested at several points and the average of the several readings recorded as representing the efficiency of the tire.

NUMBER OF CELLS IN STANDARD BATTERY EQUIPMENT

It is recommended that the number of cells in lead acid type batteries be 42, and the number of cells in the nickel iron alkaline type 60.

INTERNATIONAL STANDARDIZATION

The question of the Society making recommendations for adoption as international standards by the U. S. National Committee of the International Electro-technical Commission was given consideration by the Division, and the suggestion is offered that it might be desirable to take some procedure in this direction by offering to this committee the recommended practices which our Society has accepted covering electric vehicle charging plugs and receptacles, and which also have become standard practice of the Electric Vehicle Association of America and the Incorporated Municipal Electric Association of England. It is the opinion of this Division that other recommended practices of the Society might be advanced for international adoption and the taking of some action in this particular instance might serve as a basis of future action in this direction.

Respectfully submitted.
ELECTRIC VEHICLE DIVISION,
ARTHUR J. SLADE,
Chairman.

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SUGGESTION FOR STANDARD ROLLER BEARING SIZES

Inch Sizes				Annular Replacement Sizes					N. D. Replacement Sizes				
Bore	O.D.	Width	Approx. Load	Ball Bg. No.	Bore	O.D.	Width	Approx. Load	Ball Bg. No.	Bore	O.D.	Width	Approx. Load
1	2 7/16	1 1/16	630	305	.9843	2.4409	.669	215	305	.984	2.4409	1	760
1 3/16	2 1/8	1 15/16	520						306	1.1811	2.8346	1 3/16	1035
1 1/8	3 1/8	1 13/16	800	407	1.3780	3.9370	.984	990	207	1.3780	2.8346	1/8	690
									307	1.3780	3.1496	1 1/8	1350
1 1/2	3 3/16	1/16	650										
1 1/2	3 1/4	1 1/4	1025	308	1.5748	3.5433	.906	675	308	1.5748	3.5433	1 1/8	1700
1 1/8	3 1/2	1 1/4	1150	408	1.5748	4.3307	1.063	1330					
1 3/4	3 3/16	1/16	675	209	1.7717	3.3465	.748	420	209	1.7717	3.3465	1	1100
1 3/4	3 5/16	1 3/16	795	309	1.7717	3.9370	.984	675	309	1.7717	3.9370	1 9/16	2100
1 3/4	3 1/2	1 7/16	1140	409	1.7717	4.7245	1.142	1500					
1 7/8	3 11/16	1 1/16	675										
1 7/8	3 11/16	1 7/16	1050										
1 7/8	4	1 3/4	2000	210	1.9685	3.5433	.787	435	310	1.9685	4.3307	1 3/4	2600
2	4	1 1/8	1675	310	1.9685	4.3307	1.063	810					
2 1/4	5 3/16	2 1/16	4000	211	2.1654	3.9370	.827	600	311	2.1654	4.7244	1 13/16	3050
2 1/8	4 7/16	1 7/16	1200	311	2.1654	4.7244	1.142	1500					
2 1/2	4 7/16	1 1/16	1175						312	2.3622	5.1181	2 1/8	3500
2 1/4	4 3/4	1 3/4	2500						313	2.5591	5.5118	2 5/16	4200
2 1/4	5 7/8	2	5000						314	2.7559	5.9055	2 1/2	4850
3 1/8	6 5/16	2 13/16	5000						315	2.9527	6.2992	2 11/16	5550
4	7 1/2	2 1/2	6725						316	3.1496	6.6929	2 11/16	6300
4 1/4	8 1/8	2 1/8	9500						217	3.3464	5.9055	1 3/4	4100

Submitted by Ball and Roller Bearings Division for discussion

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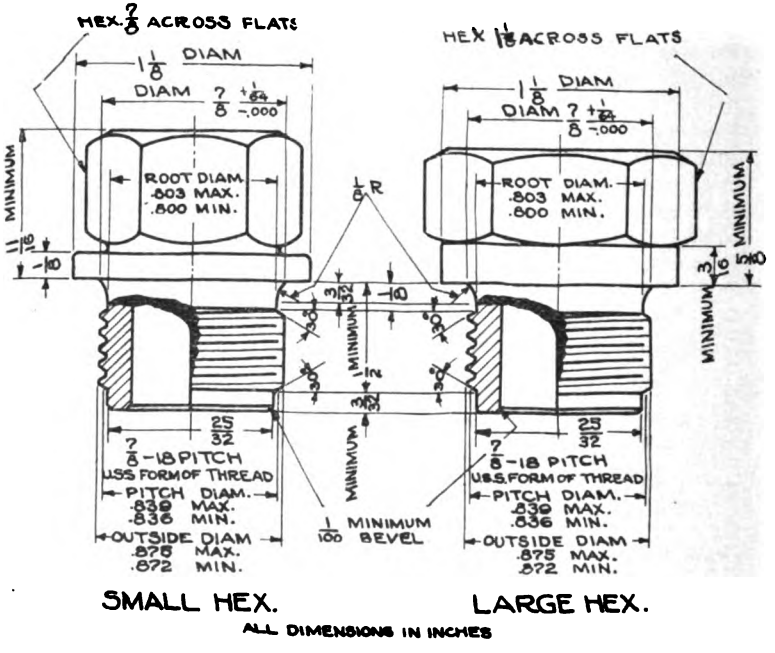
FIFTH REPORT OF THE MISCELLANEOUS DIVISION.

(AS ACCEPTED)

SPARK PLUG SHELLS AND THREAD DATA

The spark plug shells illustrated herewith are recommended for practice.



The new recommendation does not involve a change of the present spark plug standard, but merely the addition of another shell to take a larger porcelain.

If spark plug taps are made to dimensions shown on the accompanying table, the plugs can be turned in by hand, using a wrench only for final tightening. This table of dimensions is quite interesting, inasmuch as it does not refer to a standard thread, as far

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as limits and tolerances are concerned. A very fine drawn dimension is worked out between the tap and the plug, so as to have a free turning plug that can be put in by hand.

THREAD DATA
7/8—18 U. S. S. FORM OF THREAD

	Nominal Dimension	THREAD LIMITS	
		Spark Plug	Tap
Outside diameter.....	.875	.872 Min. .875 Max.	.877 Min. .879 Max.
Pitch diameter.....	.839	.836 Min. .839 Max.	.841 Min. .843 Max.
Root diameter.....	.803	.800 Min. .803 Max.	.805 Min. .807 Max.

Tap Drill Diameter
Nominal $\frac{13}{16}$ = .8125
.810 Min. .813 Max.

All dimensions in inches.

THREAD PITCH STANDARD ABOVE 1½" DIAMETER

We recommend as standard for diameters of thread greater than 1½" the pitches given below.

We submit herewith (2) two series of pitches to be known as Fine and Coarse, respectively.

The Coarse Threads to be as follows:

Beginning at 1⅝" diameter and advancing by ⅛" increments and extending to 2⅞" diameter inclusive, 12 threads per inch.

Beginning with 3" diameter and advancing by ⅛" increments to 5⅞" diameter inclusive, 10 threads per inch.

Beginning with 6" diameter and advancing by ⅛" increments up, 8 threads per inch.

The Fine Threads to be as follows:

Beginning with 1⅝" diameter and advancing by ⅛" increments up, 16 threads per inch.

All threads to be U. S. S. Form.

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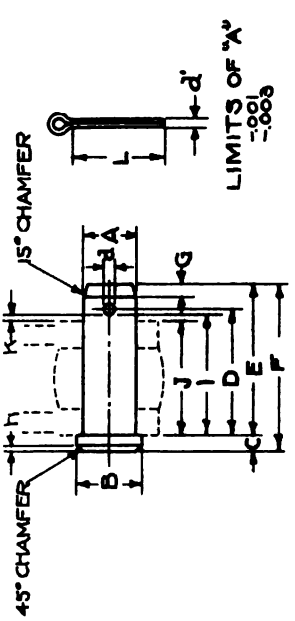
YOKE AND ROD END PINS

We recommend for acceptance standard yoke and rod end pins as shown on the accompanying drawing.



A	B	C	D	E	F	G	H	I	J SAE STANDARD YOKE	K	COTTER d'	COTTER L	d-DRILL NO	d-DRILL DIA.	DIFF. d-d'	DIFF. +K*
3/16	5/16	1/16	31/64 .4844	19/32	21/32	3/64	1/64	.4464	7/16 .4375	.0089	1/16 .0625	5/16	48	.076	.0135	.0224
1/4	3/8	3/32	43/64 .6719	51/64	57/64	1/16	1/32	.6339	5/8 .625	.0089	1/16 .0625	7/16	48	.076	.0135	.0224
5/16	7/16	3/32	13/16 .8125	31/32	1 1/16	5/64	1/32	.7595	3/4 .750	.0095	3/32 .0937	1/2	36	.106	.0123	.0218
3/8	1/2	1/8	15/16 .9375	1 3/32	1 7/32	5/64	1/32	.8845	7/8 .875	.0095	3/32 .0937	5/8	36	.106	.0123	.0218
7/16	9/16	5/32	1 1/16 .0625	1 15/64	1 25/64	3/32	3/64	1.0095	1 1.000	.0095	3/32 .0937	3/4	36	.106	.0123	.0218
1/2	5/8	5/32	1 1/64 1.2031	1 27/64	1 37/64	7/64	3/64	1.1331	1 1/8 1.125	.0081	1/8 .125	7/8	28	.140	.0150	.0231

ALL DIMENSIONS IN INCHES * TOTAL CLEARANCE YOKE TO COTTER

S. A. E. Yoke and Rod End Pins

Respectfully submitted.

MISCELLANEOUS DIVISION,

J. G. Utz, *Chairman.*

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FOURTH REPORT OF THE SPRINGS DIVISION

(NOT ACCEPTED)

The Division decided that the results of its previous meetings held during 1914 should be reviewed and that the recommendations made at these meetings as well as the last meeting should be submitted as the fourth report of the Springs Division.

MASTER LEAF LENGTHS

(1) Leaving wide latitude for individuality of design, some of the Division believe it possible to standardize the developed lengths of master leaves, beginning at the shortest length desirable and advancing by even inches to the greatest desirable length. It has been suggested that the shortest master leaf be 26″ and the longest 66″.

After carefully considering this subject, in conjunction with various spring manufacturers, your committee has decided that it is not practicable to standardize the developed length of master leaves.

BEADS AND SLOTS

(2) Several members of the Society have brought up the question of standardizing the location of the beads and slots provided for the alignment of spring leaves. After taking this point up with various spring manufacturers, the Division reports that owing to the number of variables entering into spring construction, it is not practicable to standardize the location of beads and slots.

ELLIPTIC SPRING ENDS

(3) On account of the small number of elliptic springs used, we believe it not advisable to attempt to standardize the dimensions of the ends of main leaf termed the head.

RECOMMENDATIONS

NOMENCLATURE

CANTILEVER SPRINGS

(4) The cantilever spring is not mentioned in the nomenclature of the previous reports of the Division. As this type of spring is in considerable use at the present time, it is recommended that the names indicated on the illustrations shown herewith be adopted for the respective forms of cantilever spring.

We have also recommended that where a multiple number of either form is used, either superimposed or in parallel plane, they should be designated by a prefix indicating the multiple.

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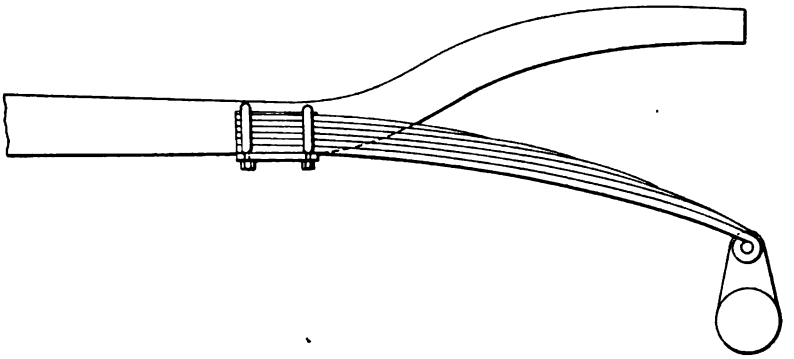

Fig. 1. One-quarter-elliptic Cantilever

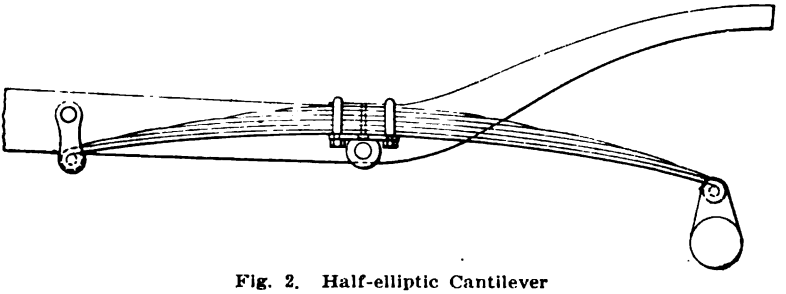

Fig. 2. Half-elliptic Cantilever

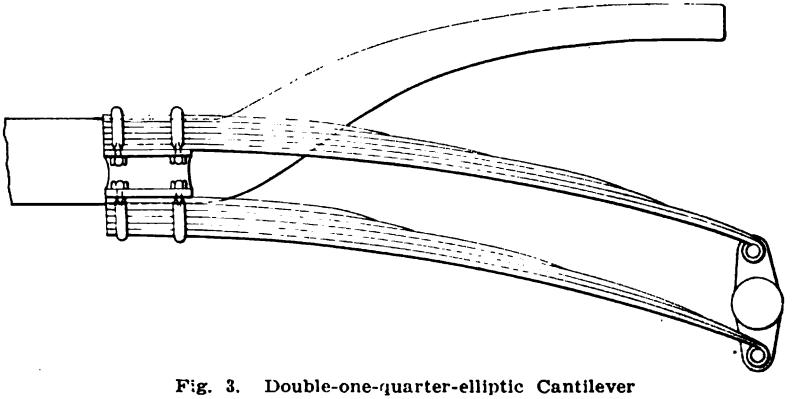

Fig. 3. Double-one-quarter-elliptic Cantilever

TESTS

(5) A standard test for the parallelism of eyes and master leaf is recommended as follows:

"Eyes of main leaves to be parallel and square, within specified

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limits, to the main leaf and parallel to each other. The test to be made by inserting two 3′ bars in the eyes, the ends not to be more than ⅜″ out of true with each other or with the main leaf."

EYE BUSHING AND BOLT TOLERANCES

(6) The Division recommends that the tolerance on bushed eyes of leaf springs be changed from

+ .000 (recommendation accepted at the Jan-
— .002 uary, 1913, meeting of the Society)
to + .002
— .001

Also that the tolerance of bolts for bushed eyes be changed from

— .003 (recommendation accepted at the Jan-
— .004 uary, 1913, meeting of the Society)
to — .002
— .004

Also that the tolerance of eyes not bushed be changed from

+ .000 (recommendation accepted at the Jan-
— .005 uary, 1913, meeting of the Society)
to + .002
— .001

Also that the tolerance of bolts for eyes not bushed be changed from

— .007 (recommendation accepted at the Jan-
— .008 uary, 1913, meeting of the Society)
to — .002
— .004

WRAPPED EYES

(7) Wrapped eyes should not be specified on pleasure car springs.

WIDTH OF SPRING ENDS

(8) Your committee believes that all spring ends should be finished and therefore recommends that spring ends be finished to a width of 1/16″ less than the nominal width of the springs, with a plus or minus tolerance of .005″, to a point far enough back on the spring to allow free shackle movement or free sliding movement in case of flat end springs.

FRAME BRACKETS

(9) Frame brackets at the point of connection with spring eyes should provide sufficient clearance to allow the eye of the spring to work freely without the necessity of grinding the outer diameter of the spring eye or machining the inner radius of the hooded portion of the bracket.

It is therefore recommended that the inner radius of the bracket hood be determined by the following formula: one-half of bolt diam-

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eter plus ⅛" for bushing wall, plus ⅝" for maximum thickness of spring leaf, plus ⅛" for clearance. The formula would then read:

$$R = \frac{D}{2} + \frac{5}{8}''$$

where

R = inner radius of hood
D = diameter of shackle bolt.

It is also recommended that the distance between the ears of bracket hoods should be .010 greater than the finished width of the spring eyes, with a minus tolerance of .000 and a plus tolerance of .005.

The above recommendation also applies to the location of bars and the width between bosses where bar shackles are used.

OFFSET OF CENTER BOLTS

(10) At the present time there seems to be no fixed rule for the offset of center bolts. For the purpose of approaching a standard in this respect, your committee recommends that the following table of offsets be adopted:

Spring Length	Offset	Equals
36"	1"	17 x19
36"	1½"	16½x19½
38"	1"	18 x20
38"	1½"	17½x20½
40"	1"	19 x21
40"	1½"	18½x21½
40"	2"	18 x22
42"	1"	20 x22
42"	1½"	19½x22½
42"	2"	19 x23
44"	1"	21 x23
44"	1½"	20½x23½
44"	2"	20 x24
46"	1"	22 x24
46"	1½"	21½x24½
46"	2"	21 x25
48"	1"	23 x25
48"	1½"	23½x25½
48"	2"	22 x26
48"	2½"	21½x26½
50"	1"	24 x26
50"	1½"	23½x26½
50"	2"	23 x27
50"	2½"	22½x27½
52"	1"	25 x27
52"	1½"	24½x27½
52"	2"	24 x28
52"	2½"	23½x28½
54"	1"	26 x28
54"	1½"	25½x28½
54"	2"	25 x29
54"	2½"	24½x29½
56"	1"	27 x29
56"	1½"	26½x29½
56"	2"	26 x30
56"	2½"	25½x30½
58"	1"	28 x30
58"	1½"	27½x30½
58"	2"	27 x31
58"	2½"	26½x31½
60"	1"	29 x31
60"	1½"	28½x31½
60"	2"	28 x32
60"	2½"	27½x32½

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It will be observed that offsets of less than 1" or more than 2½" are not recommended. The first for the reason that offsets of less than 1" lead to errors in assembling springs on the car and in assembling the spring leaves themselves, due to the slight difference in the length of the front and rear part of the spring. The second for the reason that proper distribution of the metal is made difficult through greater offset than 2½".

NUTS FOR SPRING CLIPS

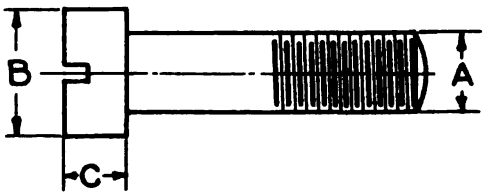
(11) The Division recommends that the standard nut for spring clips have S. A. E. hex nut dimensions, except that the height should be one and one-half times the diameter of the threaded portion of the clip.

Sizes of the threaded portion of clips are given in table, Paragraph 14.

CENTER BOLTS

(12) For reasons connected with the manufacture of cold forged center bolts which are generally used in connection with leaf springs, your committee recommends the following changes from accepted S. A. E. standards. (See 1912 Transactions, Part 1.)

That the head of the bolt be changed to what is termed *Flat Fillister Head* as shown in the sketch below.



That the dimensions for the various spring widths be changed to read as follows:

PLEASURE CARS

Spring Width	A	B	C
1¼", 1½", 1¾", 2".....	5/16	½	⅜
2¼" and 2½".....	⅜	½	⅜

NOTE:—Where springs of greater width than 2½" are used on pleasure cars, use center bolts recommended for commercial car springs of similar width.

COMMERCIAL CARS

Spring Width	A	B	C
2"	5/16	½	⅜
2¼", 2½" and 3".....	⅜	⅝	⅜
3½" and 4".....	7/16	⅝	½
Over 4"	½	¾	½

All center bolt threads to be S. A. E. standard.

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CENTER BOLT NUTS

(13) It has been found in practice that S. A. E. standard diameter hexagon nuts (unless made of special steel) do not contain enough metal across the flats to withstand the strain of drawing the spring leaves together, particularly in the case of heavy truck springs, in addition to the strain caused by rough handling in transportation; the latter strain seems to be the principal cause of failure, springs frequently arriving at destination in a dissembled condition. Therefore, your committee recommends that for hexagon nuts used on spring center bolts, the U. S. standard cold pressed blanks tapped with S. A. E. standard threads be used.

SPRING WIDTHS

(14) The subject of width of springs for specified loads or for cars of specified weights is one that may be approached from so many angles that specifications which will cover the entire range of motor car construction and conditions are hardly practicable at this time. As a step in the directon of standardiaztion the Division recommends for discussion and possible adoption the following table of spring widths for various loads, together with eye diameters and spring clip diameters for the respective springs. In the table only half-elliptic and three-quarter elliptic suspension is considered, these representing average practice.

The table of width and spring clip diameters is formulated not from a standpoint of theory, but from what is at the present time accepted practice, both in this country and abroad. The widths given are those which we believe would be recommended by the various

PLEASURE CARS

Car Weight	*Location*	*Approx. Load per Spring, Pounds*	*Spring Width, in.*	*Eye Dia. in.*	*Spring Clip Diameters, in.*	
					Carbon	*Alloy*
1800 pounds to 2600 pounds	Front	500 to 700	1¾	⅝	½	7/16
	Rear	600 to 750	1¾	⅝	½	7/16
2600 pounds to 3200 pounds	Front	600 to 800	2	⅝	9/16	½
	Rear	700 to 900	2	⅝	9/16	½
3200 pounds to 4000 pounds	Front	750 to 1000	2¼	⅝	⅝	9/16
	Rear	850 to 1100	2¼	⅝	⅝	9/16
Over 4000 pounds	Front	Over 1000	2½	¾	.....	⅝
	Rear	Over 1100	2½	¾	.....	⅝

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spring manufacturers for the loads specified. When alloy steel clips are used they should be heat treated.

The table of shackle bolt diameters is formulated solely from the viewpoint of possibility of lubrication, keeping the pressures at approximately 400 pounds per square inch or lower under total loads. Because of small bearing surface the bolts in the shackles should be positively prevented from oscillating in the shackles.

NOTE:—Weights given are for cars empty; while spring loads given are for total loads with passengers and equipment.

NOTE:—Where rear springs take drive or both drive and torque, add ⅛" to eye diameter on driving end. Where rear springs take drive or both drive and torque or are underslung, add 1/16" to clip diameter. Where rear springs are used in cantilever form, it is recommended that the center trunnion pins be of a diameter to equal one-half of spring width.

COMMERCIAL CARS

Capacity	*Location*	*Approx. Load per Spring, Pounds*	*Width, in.*	*Eye Dia., in.*	*Spring Clip diameters (Alloy Steel) in.*
¾ Ton	Front	700 to 850	2¼	¾	⅝
	Rear	1250 to 1500	2¼	⅞	⅝
1 Ton	Front	800 to 950	2½	¾	⅝
	Rear	1600 to 1900	2½	1	¾
1½ Tons	Front	900 to 1050	2½	¾	⅝
	Rear	1900 to 2500	3	1	¾
2 Tons	Front	1000 to 1250	2½	¾	⅝
	Rear	2500 to 3500	3	1⅛	¾
3 Tons	Front	1200 to 1550	3	¾	¾
	Rear	3800 to 4500	3½	1¼	⅞
5 Tons	Front	1500 to 1850	3	⅞	¾
	Rear	6000 to 7500	3½ or 4	Flat ends	1
7 Tons	Front	1800 to 2300	3	1	¾
	Rear	8000 to 9500	4 or 5	Flat ends	1

NOTE:—Where rear springs are underslung, add ⅛" to clip diameter.

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Carbon steel spring clips are not recommended for commercial cars.

FUTURE WORK

In conclusion, we have for future consideration:

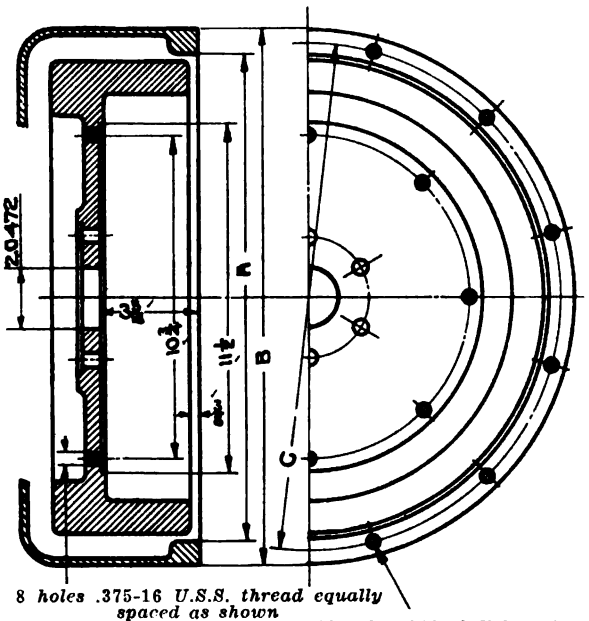
1. A further standardization of spring clips, as to length of shank, opening, etc.
2. Spacing of clips.
3. Pressure blocks.
4. Length of spring seat.
5. Material between spring and spring seat.
6. Amplification of tables given in Paragraph 14 hereof.
7. Development of standard inspection methods and physical tests.
8. Standard tolerance as to height and load of completed spring.

Respectfully submitted,

SPRINGS DIVISION,
C. W. McKINLEY,
Chairman.

S. A. E. BELL HOUSING DIMENSIONS AS ADOPTED AT THE ANNUAL MEETING, JANUARY, 1915.

(Standards Exchange Division Report)



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Type	A	B	C
1	20 1/8	21 3/4	20 7/8
2	17 5/8	19 3/8	18 3/8
3	16 1/8	17 3/4	16 7/8
4	14 1/4	16	15
5	12 3/8	14	13 1/4

All dimensions in inches.

FIFTH REPORT OF CARBURETER FITTINGS DIVISION.

(AS ACCEPTED)

SIDE-OUTLET CARBURETER FLANGES

Some time ago certain manufacturers of automobile motors of the block type requested that steps be taken to standardize the method of locating the position of the connecting flange on side-outlet carbureters, in order to avoid the confusion which now exists.

This has been carefully considered by the Carbureter Fittings Division, and after much correspondence between the members and with those most concerned, engine builders and carbureter manufacturers, we recommend the retention of the present standard flange dimensions, and the placing of the long diameter of the flange in a *vertical* plane, for carbureters of the side-outlet type.

FLARED TUBE UNIONS AND UNION FITTINGS.

It has been found in actual practice that the tolerance now specified for the union nut bore (dimensions *M*, S. A. E. Data Sheet 35a, Volume I) is not sufficient for practical screw machine manufacturing and we therefore recommend that it be increased from .002" to .005" for all sizes.

The revised dimensions for *M* would be as follows:

	1/4"	5/16"	3/8"	7/16"	1/2"
M Bore, female part	0.255	0.317	0.380	0.442	0.505
	0.260	0.322	0.385	0.447	0.510

Owing to the demand for S. A. E. Standard Flared Tube Unions and Fittings in sizes larger than those now listed, we recommend the addition of 5/8" and 3/4" sizes.

Respectfully submitted.

CARBURETER FITTINGS DIVISION,
C. W. STIGER,
Acting Chairman.

Herewith are given uptodate dimensional tables of flared tube union, ell and tee recommended practice.

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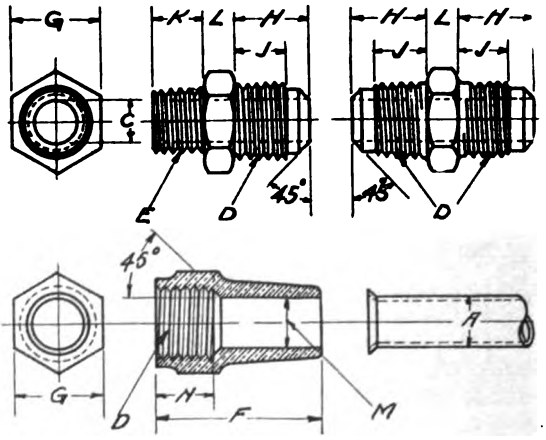
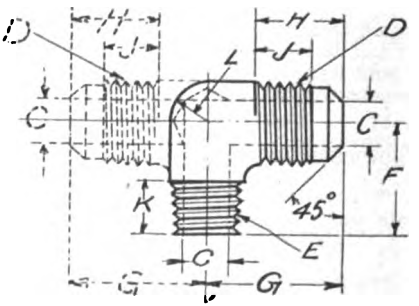
FLARED TUBE UNIONS



A	Pipe diameter	1/4	5/16	3/8	7/16	1/2	5/8	3/4
C	Bore, male part	11/64	15/64	19/64	23/64	27/64	35/64	43/64
D	S. A. E. thread	7/16x20 thr.	1/2x20 thr.	9/16x18 thr.	5/8x16 thr.	3/4x16 thr.	7/8x14 thr.	1x14 thr.
E	Pipe thread	1/4	5/16	3/8	7/16	1/2	5/8	3/4
F		1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	2 3/16
G		7/16	1/2	9/16	5/8	3/4	1 1/16	1 1/16
H		1/2	5/8	11/16	13/16	15/16	1	1
J	Thread only	13/32	1/2	9/16	5/8	3/4	13/32	13/32
K	Thread only	1/2	1/2	5/8	5/8	1/2	5/8	1/2
L		1/16	1/16	1/16	1/16	1/16	1/16	1/16
M	Bore, female part	0.255-0.260	0.317-0.322	0.380-0.385	0.442-0.447	0.505-0.510	0.630-0.635	0.755-0.760
N		13/32	1/2	9/16	5/8	3/4	13/32	13/32

FLARED TUBE ELLS AND TEES



A	Tube diameter	1/4	5/16	3/8	7/16	1/2	5/8	3/4
C	Drill diameter	11/64	15/64	19/64	23/64	27/64	35/64	43/64
D	S. A. E. thread	7/16x20	1/2x20	9/16x18	5/8x16	3/4x16	7/8x14	1x14
E	Briggs std. pipe thd	1/4	5/16	3/8	7/16	1/2	5/8	3/4
F	Center to face	1/2	1/2	1/2	11/16	1	1 1/16	1 1/16
G	Center to face	1/2	11/16	1	1 1/16	1 3/16	1 3/16	1 1/16
H		1/2	5/8	11/16	13/16	15/16	1	1
J	Thread only	13/32	1/2	9/16	5/8	3/4	13/32	13/32
K	Thread only	1/2	1/2	5/8	5/8	1/2	5/8	1/2
L	Radius	1/2	1/2	5/8	5/8	3/4	13/16	13/16

All dimensions on this sheet in inch measure.

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THIRD REPORT OF PLEASURE CAR WHEELS DIVISION

(AS ACCEPTED)

STANDARD TIRE AND RIM SIZES.

In its second report your Division drew up a set of tire sizes as a suggestion for standard. This matter has been further considered in conjunction with the Clincher Automobile Tire Manufacturers' Association, and we now recommend for adoption the following table of standard tire and rim sizes which is similar to our previous suggestion with the addition of a new 36" x 5" size.

Rim Sizes	Tire Sizes	Tire Seat Diameter
30 x 3	30 x 3	24"
30 x 3½	30 x 3½	23"
32 x 3½	32 x 3½	25"
32 x 4	32 x 4	24"
34 x 4	34 x 4	26"
34 x 4½	34 x 4½	25"
36 x 4½	36 x 4½	27"
36 x 5	36 x 5	26"
38 x 5½	38 x 5½	27"

It will be noted that the above sizes are so-called "even sizes." They are recommended as the only tire sizes from which automobile manufacturers shall take their equipment. When such are used as initial equipment, they will allow the consumer to use oversize tires at his pleasure, on the rims with which his car is already equipped, thereby giving him more carrying capacity, easier riding qualities, increased tire life, etc. The tire manufacturers will manufacture odd size (oversize) tires in every case for the above even sizes, and we recommend that these oversize tires shall not be used in any case as initial equipment by a vehicle manufacturer. They shall be strictly and absolutely consumers' tires. The following table will show the oversize tires available for the above mentioned list.

Rim Sizes	Even Tire Sizes (for manufacturers and consumers)	Odd or Oversize Tires (for consumers only)
30 x 3	30 x 3	31 x 3½
30 x 3½	30 x 3½	31 x 4
32 x 3½	32 x 3½	33 x 4
32 x 4	32 x 4	33 x 4½
34 x 4	34 x 4	35 x 4½
34 x 4½	34 x 4½	35 x 5
36 x 4½	36 x 4½	37 x 5
36 x 5	36 x 5	37 x 5½
38 x 5½	38 x 5½	39 x 6

The 36 x 5 rim will be a rim identical in section with the present

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4½" or F section rim, except that its width between flanges will be half way between the present 4½" or F section rim and 5½" or G section rim. Its tire seat diameter will be the same as the present 36 x 5 (26") and the rim will receive any 36 x 5 tire at present on the market or manufactured. The extra width permits the use of an oversize 37 x 5½ tire very much better than did the old 36 x 5 narrow width rim.

This brings us down to nine regular tire sizes with nine oversizes, eighteen different tires in all, these tires including over 83 per cent. of the tires in use at the present day. This constitutes a considerable reduction of sizes; at present upwards of fifty tire sizes are manufactured by the larger tire companies.

Respectfully submitted.

PLEASURE CAR WHEELS DIVISION,

HENRY SOUTHER,

Chairman.

ON NOMENCLATURE OF AUTOMOBILE PARTS

In taking up the matter of nomenclature which, in the view of the Council is one of great importance from a money-saving point of view, an investigation was first made to determine to what extent variation in nomenclature exists in the parts lists now in use by car manufacturers. In this investigation the parts lists of only eight manufacturers were used. As a starting point the name of a given part was looked up in one parts list, and then compared with the corresponding names in the seven other parts lists. The names of twenty-seven elements in the cylinder group were checked in this way. One hundred and eighty-two terms were looked up, of which 24 or 13% represented uniform nomenclature. Of the total 27 elements in only 13 cases was there any uniformity and in only 5 cases did more than 2 of the 8 manufacturers use the same name for the same part. That is, it was found that in the case of 87% of the terms investigated no two manufacturers used the same name for the same part.

It is realized that to complete the work of nomenclature by this method it would be necessary to use a great many other parts lists. Since it took on an average of twenty minutes to secure the limited information mentioned above for each term, some idea may be gained of the amount of work necessary to obtain a complete report on present variation. It is estimated that it would take a competent

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man and an assistant at least six months to tabulate the information from the parts lists of eight manufacturers alone, estimating fifteen hundred as the number of dissimilar parts which would require standard names.

Another course open to us is to have representatives of the manufacturers of the various groups or assemblies of the motor car, supply standard names for all parts included in the respective groups. The following is a list of assemblies or groups of parts which it is the purpose to expand into lists of names. For this purpose the motor car is divided into four general divisions. Each of these general divisions is further divided into sub-divisons and the subdivisions divided again into natural or arbitrary groups. Then each group will be considered separately and a standard set of names for the comparatively small number of parts contained in it decided upon. Attempt will be made to so limit the scope of each group that there will be no misunderstanding as to what is included in it.

General Divisions

I. POWER PLANT.
II. TRANSMISSION SYSTEM.
III. RUNNING GEAR.
IV. BODY.

General Division I

POWER PLANT

A. ENGINE.
B. FUEL SYSTEM.
C. IGNITION SYSTEM.
D. COOLING SYSTEM.
E. LUBRICATION SYSTEM.
F. STARTING AND LIGHTING SYSTEM.
G. CLUTCH.
H. ACCESSORIES.

General Division II

TRANSMISSION SYSTEM

A. TRANSMISSION.
B. CONTROL.

General Division III

RUNNING GEAR

A. REAR AXLE.
B. FRONT AXLE.
C. WHEELS.
D. FRAME.
E. SPRINGS.
F. STEERING GEAR.
G. MUFFLER.

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General Division IV

BODY

A. BODY.
B. TOP.
C. HOOD.
D. RUNNING BOARDS.
E. FENDERS.
F. TIRE CARRIERS.
G. WINDSHIELD.
H. LAMPS.
J. ACCESSORIES.

General Division I

POWER PLANT

Sub-division A.

ENGINE.

Group 1. CYLINDER.
Includes all parts usually assembled therewith, such as studs, valve caps, wire brackets, gaskets, water header.

Group 2. CRANKCASE.
Includes all parts usually assembled therewith, such as studs, bearings, gaskets.

Group 3. CRANKSHAFT.
Includes all parts usually assembled therewith, such as timing gear, flywheel, oil connections.

Group 4. CAMSHAFT.
Includes all parts usually assembled therewith, such as timing gear, oil pump gear, pressure pump cam.

Group 5. CONNECTING-ROD AND PISTON.
Includes all parts usually assembled therewith, such as bearings, shims, pin, rings.

Group 6. VALVE.
Includes valve-lifting mechanism above cam, tappet, spring, etc.

Group 7. IGNITION DRIVE.
Includes parts used to drive ignition devices, up to and including coupling.

Group 8. AUXILIARY DRIVE.
Includes parts used to drive electric lighting and starting system, tire pump, etc., up to and including coupling.

Group 9. WATER PUMP.

Group 10. OIL PUMP.

Group 11. STARTING CRANK.

Group 12. FAN.
Includes bracket, drive pulley, belt.

Group 13. INTAKE MANIFOLD.
Includes cylinder gaskets, nuts.

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(I-A *Continued*)

Group 14. EXHAUST MANIFOLD.
Includes cylinder gaskets, nuts.
Group 15. FUEL PRESSURE REGULATOR.

Sub-division B.

FUEL SYSTEM.

Group 1. CARBURETER.
Group 2. TANK.
Group 3. FUEL GAGE.
Group 4. PRESSURE GAGE.
Group 5. CARBURETER HEATING SYSTEM.
Group 6. FUEL PIPING.
Includes piping and unions to gage and auxiliary tank.
Group 7. PRESSURE PIPING.
Includes piping and unions to gage.
Group 8. THROTTLE CONTROL.
Includes parts from hand throttle lever at bottom of steering column, and foot throttle to throttle lever on carbureter, together with all brackets, cross-shafts, springs, etc.
Group 9. CARBURETER DASH ADJUSTMENT.
Group 10. AUXILIARY FUEL TANK.

Sub-division C.

IGNITION SYSTEM.

Group 1. MAGNETO OR GENERATOR.
Group 2. BATTERY.
Group 3. CABLES.
Includes terminals.
Group 4. SPARK PLUGS.
Group 5. WIRING.
Includes all ignition wiring, except cables from ignition device to spark plug.
Group 6. TIMER AND DISTRIBUTOR.
Group 7. COIL.
Group 8. CONTROL SYSTEM.
Includes switch and parts from ignition lever at bottom of steering column to spark lever on magneto, together with all brackets, cross-shafts, etc.

Sub-division D.

COOLING SYSTEM.

Group 1. RADIATOR.
Includes radiator support, hood bracket and draining device.

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(I-D *Continued*)

Group 2. RADIATOR CONNECTIONS.
Includes hose and fastening devices.

Sub-division E.

LUBRICATION SYSTEM.

Group 1. TANK.
Includes strainers, etc. Where tank is part of crankcase, strainers, etc., should be included under that head.

Group 2. PIPING.
Includes all piping (except oil leads within crankcase), connections for same, etc.

Group 3. SIGHT-FEEDS.

Group 4. PRESSURE GAGE.

Group 5. LEVEL GAGE.

Sub-division F.

LIGHTING AND STARTING SYSTEM.

Group 1. GENERATOR.

Group 2. MOTOR.

Group 3. WIRING.
Includes all wiring for starting, lighting and electric accessory circuits.

Group 4. INSTRUMENTS.
Includes fastening devices.

Group 5. STARTING DRIVE.
Includes parts used to drive engine by electric motor.

Group 6. CONTROL SYSTEM.
Includes switches, levers, resistance, etc.

Group 7. JUNCTION BOX.
Includes connectors and fuses.

Sub-division G.

CLUTCH.

Group 1. HOUSING.

Group 2. PLATES OR DISKS.

Group 3. CONE.

Group 4. FACING.

Group 5. SPRING.

Group 6. THRUST BEARING.

Group 7. COUPLING.

Group 8. THROW-OUT COLLAR.

Group 9. CONTROL.
Includes pedal and all connections, brackets, cross-shafts, etc.

Group 10. ADJUSTING DEVICE.

Group 11. CLUTCH BRAKE.

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Sub-division H.

ACCESSORIES.

Group 1. TIRE PUMP.
Includes tubing and connectors.

Group 2. HORN (IF ON MOTOR).
Includes brackets and button, but not wiring.

General Division II

TRANSMISSION SYSTEM

Sub-division A.

TRANSMISSION.

Group 1. CASE.
Includes all parts regularly assembled with both upper and lower halves, such as studs, cover-plates.

Group 2. MAIN-SHAFT.
Includes gears thereon and drive gear.

Group 3. COUNTERSHAFT.
Includes gears thereon.

Group 4. REVERSE SHAFT.
Includes gears and bushings thereon.

Group 5. BEARINGS.
Includes bearing housings and adjustments.

Group 6. SHIFTING MECHANISM.
Includes shifter rods, forks, etc.

Group 7. INTERLOCKING DEVICE.

Sub-division B.

CONTROL.

Group 1. GATE.
Includes bracket.

Group 2. LEVER.
Includes latch, etc.

Group 3. CROSS-SHAFT.
Includes bearings, brackets, etc.

General Division III

RUNNING GEAR

Sub-division A.

REAR AXLE.

Group 1. HOUSING.
Includes all devices mounted thereon, such as spring pads, brake-shaft brackets, shock absorber brackets, bumpers.

Group 2. TORQUE TUBE AND CONNECTIONS.
Includes bracket or housing at front end.

Group 3. PROPELLER-SHAFT.
Includes universal joints.

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(III-A *Continued*)

Group 4. RADIUS RODS.
Group 5. BEVEL GEARS.
Includes pinion, gear, bearings and adjusting devices.
Group 6. DIFFERENTIAL.
Includes case, shafts, gears, pinions, etc.
Group 7. DRIVING SHAFTS.
Includes bearings.
Group 8. SERVICE BRAKE.
Includes adjusting device.
Group 9. SERVICE BRAKE CONTROL.
Includes parts, such as rods, levers, pedal, brackets (except on rear axle housing), cross-shafts, equalizers.
Group 10. EMERGENCY BRAKE.
Includes adjusting device.
Group 11. EMERGENCY BRAKE CONTROL.
Includes parts, such as rods, levers, brackets (except on rear axle housing), cross-shafts, equalizers, etc.

Sub-division B.

FRONT AXLE.

Group 1. FRONT AXLE.
Group 2. STEERING KNUCKLE.
Includes pin, bushings, steering arm, etc.
Group 3. CROSS-ROD.
Includes rod ends, pins, etc.

Sub-division C.

WHEELS.

Group 1. FRONT WHEEL.
Includes bearings, spacers, speedometer gear, hub, hub cap, etc.
Group 2. REAR WHEEL.
Includes bearings, spacers, brake-drum, hub, hub cap, etc.

Sub-division D.

FRAME.

Group 1. FRAME.
Includes side members, cross members, gussets, etc.
Group 2. SPRING HANGERS.
Group 3. STEP HANGERS.
Group 4. LAMP BRACKETS.
Group 5. FENDER IRON BRACKETS.
Group 6. SHOCK ABSORBERS.
Includes brackets.
Group 7. PAN.
Includes connections to frame.

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Sub-division E.

SPRINGS.

Group 1. FRONT SPRING.
Includes bolts, shackles, clips, fabric seats, etc.

Group 2. REAR SPRING.
Includes bolts, shackles, clips, fabric seats, etc.

Sub-division F.

STEERING GEAR.

Group 1. STEERING GEAR.
Includes housing, bracket, steering arm, etc.

Group 2. FORE-AND-AFT ROD.
Includes joints, boots, etc.

Group 3. COLUMN.
Includes brackets and all parts enclosed in the column.

Group 4. WHEEL.
Includes sector, levers, etc.

Sub-division G.

MUFFLER.

Group 1. MUFFLER.
Includes brackets, etc.

Group 2. EXHAUST PIPE.
Includes supports, couplings, gaskets, etc.

General Division IV

BODY

Sub-division A.

BODY.

Group 1. BODY.
Includes frame, with metal covering and moldings, top irons, fender brackets where attached to body, extra seat brackets where usesd, etc.

Group 2. UPHOLSTERY AND TRIM.
Includes springs, hair, etc.

Group 3. CUSHIONS.
Includes frames, springs, hair, etc.

Group 4. EXTRA SEATS.

Group 5. DOORS.
Includes frame, metal covering, latches, etc.

Group 6. TOOL AND BATTERY BOXES (where assembled in body).

Group 7. FLOOR BOARDS.
Includes covering material, binding, clutches, finger rings, etc.

Group 8. CARPETS, MATS.

Group 9. ROBE RAIL, FOOT REST, ETC.

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Sub-division B.

TOP.

Group 1. BOWS.
Includes sockets, hinges, etc.

Group 2. COVERING.
Includes all material used in covering top, such as celluloid.

Group 3. BOW SUPPORTER.

Group 4. TOP BOOT.

Group 5. STORM CURTAINS.

Group 6. TOP SUPPORT.
Includes straps, clips, or other devices used to hold top up.

Sub-division C.

HOOD.

Group 1. HOOD.
Includes hinges, handles, hold-down clips, etc.

Group 2. HOOD SUPPORT BRACKET.

Group 3. HOLD-DOWN CLIPS.
Includes parts not fastened permanently to hood.

Sub-division D.

RUNNING BOARDS.

Group 1. RUNNING BOARDS.
Includes cover material, binding, etc.

Group 2. SIDE SHIELDS.

Subdivision E.

FENDERS.

Group 1. FRONT FENDERS.

Group 2. REAR FENDERS.

Group 3. FENDER IRONS.
Includes brackets not permanently mounted on body or frame.

Sub-division F.

TIRE CARRIERS.

Group 1. BRACKETS.
Includes means of fastening tire carrier to car.

Group 2. STRAPS.

Group 3. LOCKING DEVICES.

Sub-division G.

WINDSHIELD.

Group 1. WINDSHIELD.
Includes frame, glass, hinges, etc.

Group 2. SUPPORTING DEVICES.
Includes brackets, rods, etc.

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Sub-division H.

LAMPS.

Group 1. HEAD-LAMP.
Includes bulb, base and connector plug.

Group 2. SIDE-LAMP.
Includes bulb, base and connector plug.

Group 3. TAIL-LAMP.
Includes bulb, base and connector plug.

Group 4. DASH-LAMP.
Includes bulb, base and connector plug.

Group 5. LICENSE PAD LAMP.
Includes bulb, base and connector plug.

Sub-division J.

ACCESSORIES.

Group 1. SPEEDOMETER.
Includes brackets, pinion, shaft, etc.

Group 2. LICENSE PAD BRACKETS.

Group 3. TOOL EQUIPMENT.

Group 4. CLOCK.
Includes bracket.

Group 5. TRUNKS.

Group 6. TRUNK RACKS.
Includes means of fastening to car.

Group 7. SLIP COVERS.
Includes buttons.

Group 8. HORN.
Does not include wiring.

Group 9. TROUBLE LAMP.
Where the entire lamp with its wire is furnished as a separate unit, the trouble lamp wire is included and the wiring to the trouble lamp connection is included in I-F-3.

GENERAL REMARKS

1. A term describing the chief function of a part shall be used where there is no conventional term by which that part is known.

Example: "Valve roller holder" should be "Valve Tappet" or "Valve Lifter."

2. While on some parts whoses functions are not clear, the name of the geenral division in which they are used might prove an advantage, this is not always necessary. In fact, it sometimes makes the name of a part unnecessarily long.

Example: "Motor cylinder valve chamber plug-exhaust" should be "Exhaust valve cap."

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3. Conjunctions, prepositions, etc., should be omitted wherever possible, as they make the name of a part unnecessarily long without adding anything to clearness.

Example: "Gasket for cylinder" should be "Cylinder gasket."

4. Where two parts are closely related, by placing the simple name of one part immediately below the descriptive title of the part with which it functions, clearness is obtained without the necessity of using too long and unwieldy names.

Example: "Valve tappet adjusting screw."
"Valve tappet adjusting screw lock nut," should be
"Valve tappet adjusting screw."
"Lock nut."

Parts such as gaskets, nuts, capscrews, lockwashers, etc., are classified with the articles in the mounting of which they are installed. No mention is made of grease cups, felt washers, etc., in the different classifications, it being assumed that they will be included in the complete itemization to be made of each group by specialists.

REGISTRATION LIST OF WINTER MEETING

MEMBERS

Alden, H. W., Timken-Detroit Axle Co., Detroit, Mich.
Allen, Walter C., Bijur Motor Lighting Co., Hoboken, N. J.
Allerton, Reuben, Pyrene Mfg. Co., New York City.
Ames, Azel, Kerite Insulated Wire & Cable Co., New York City.
Anderson, Raymond M., Stromberg Motor Devices Co., Chicago, Ill.
Anglada, Joseph A., New York City.
Anibal, Benj. H., Cadillac Motor Car Co., Detroit, Mich.
Apple, V. G., Apple Electric Co., Newark, N. J.
Armstrong, J. R. C., General Vehicle Co., Long Island City, N. Y.
Arndts, E. C., Cleveland-Canton Spring Co., Canton, Ohio.
Atwell, Joseph, Michelin Tire Co., Milltown, N. J.

Bachem, Max, Crown Prince Metal Works, Detroit, Mich.
Bachman, B. B., The Autocar Co., Ardmore, Pa.
Baker, Dickerson G., New York City.
Baldwin, Harry G., New Departure Mfg. Co., Bristol, Conn.
Barthel, Oliver E., Detroit, Mich.
Barton, Henry L., General Motors Co., Detroit, Mich.
Batt, W. L., Hess-Bright Mfg. Co., Philadelphia, Pa.
Beamer, George R., U. S. Gauge Co., New York City.
Belcher, Warren J., Whitney Mfg. Co., Hartford, Conn.
Bell, John, Norma Co. of America, New York City.
Bergmann, A. C., New York City.
Beuret, Emil J., Passaic, N. J.
Bijur, Joseph, Bijur Motor Lighting Co., Hoboken, N. J.
Bliss, William Lord, United States Light & Heating Co., Niagara Falls, N. Y.
Booth, Clement, Standard Roller Bearing Co., Philadelphia, Pa.
Bowers, Lee S., Schwarz Wheel Co., Philadelphia, Pa.
Brady, Eugene J., New York City.
Brown, Charles M., Colonial Steel Co., Pittsburgh, Pa.

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Brown, H. H., Centerport, L. I.
Browne, Arthur B., Branford, Conn.
Burgess, Frank, Boston Gear Works, Norfolk Downs, Mass.
Busby, Lloyd G., Duplex Engine Governor Co., New York City.
Buxton, C. B., American Locomotive Co., Richmond, Va.

Carlton, C. C., Firestone Tire & Rubber Co., Akron, O.
Cautley, John R., Peter A. Frasse & Co., Inc., New York City.
Chalfant, Edward P., Electric Automobile Manufacturers' Association, Chicago, Ill.
Chase, Herbert, Automobile Club of America, New York City.
Chase, T. P., King Motor Car Co., Detroit, Mich.
Chatain, Henri G., General Electric Co., Erie, Pa.
Chryst, William A., Dayton Engineering Laboratories Co., Dayton, O.
Clark, E. L., Commercial Truck Co. of America, Philadelphia, Pa.
Clarkson, Coker F., S. A. E. Office, New York City.
Clayden, A. Ludlow, New York City.
Clingan, R. E., Hess-Bright Mfg. Co., Philadelphia, Pa.
Cole, Willam F., Baldwin Chain & Mfg. Co., Worcester, Mass.
Conant, W. H., Gould Storage Battery Co., Detroit, Mich.
Cookingham, D. C., Rauch & Lang Carriage Co., Cleveland, O.
Copley, A. W., Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Corse, Hugh R., Detroit, Mich.
Cumner, Arthur B., New York City.
Cunningham, R. H., Splitdorf Electrical Company, Newark, N. J.
Cuntz, Hermann F., New York City.

Davis, Charles Ethan, New York City.
Davis, Laurence R., Revere Rubber Co., Providence, R. I.
DeCampi, E. A., National Lead Co., Chicago, Ill.
Diefendorf, Willis H., New Process Gear Corp., Syracuse, N. Y.
Dorris, G. P., Dorris Motor Car Co., St. Louis, Mo.
Douglas, Theodore, Duplex Engine Governor Co., Inc., New York City.

Ehle, A. H., Baldwin Locomotive Works, Philadelphia, Pa.
Ehrman, E. H., Chicago Screw Co., Chicago, Ill.
Eriksen, Peter M., Crane Motor Car Co., Bayonne, N. J.

Favary, E., Favary Tire & Cushion Co., New York City.
Fawick, Thomas L., Fawick Motor Car Co., Sioux Falls, S. D.
Fekete, S. I., Hudson Motor Car Co., Detroit, Mich.
Findeisen, C. W., Findeisen & Kropf Mfg. Co., Chicago, Ill.
Fishleigh, Walter T., University of Michigan, Ann Arbor, Mich.
Fitzpatrick, Clarence J., Cleveland Worm & Gear Co., Cleveland, O.
Fitzpatrick, David, Cleveland Worm & Gear Co., Cleveland, O.
Foljambe, E. S., *Chilton Company*, Philadelphia, Pa.
Forbes, Kingston, Flint, Mich.
Ford, Bruce, Electric Storage Battery Co., Philadelphia, Pa.
Formigle, Otto L., Sheldon Axle Co., Wilkes-Barre, Pa.
Foss, Noble, B. F. Sturtevant Co., Hyde Park, Boston, Mass.
Fuller, George F., Wyman & Gordon Co., Worcester, Mass.
Furness, Radclyffe, Midvale Steel Co., Philadelphia, Pa.

Galbraith, Frederic W., Jr., George Automatic Roller Bearing Co., Cincinnati, Ohio.
Gallup, David L., Worcester Polytechnic Institute, Worcester, Mass.
Germane, Frank M., Standard Roller Bearing Co., Philadelphia, Pa.
Gfrorer, A. H., C. W. Hunt Company, West New Brighton, S. I.

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Gildner, H. H., S. K. F. Ball Bearing Co., New York City.
Girl, Christian, Perfection Spring Co., Cleveland, O.
Gleason, James E., Gleason Works, Rochester, N. Y.
Gray, B. D., Hess-Bright Mfg. Co., Philadelphia, Pa.
Greuter, Charles R., C. R. G. Manufacturing Co., Saugus, Mass.

Hager, Henry J., Springfield, Mass.
Halbfass, A. J., General Vehicle Co., Long Island City, N. Y.
Hall, Edwin R., Goodyear Tire & Rubber Co., Akron, Ohio.
Hall, Morris A., *Motor Life*, New York City.
Hart, W. J., Splitdorf Electrical Co., Newark, N. J.
Hatch, C. W., Perfection Spring Co., Cleveland, O.
Hatch, Darwin S., *Class Journal Publishing Co.*, Chicago, Ill.
Hayes, Clarence B., Hayes Wheel Co., Jackson, Mich.
Hayes, H. J., Hayes Manufacturing Co., Detroit, Mich.
Heald, James N., Heald Machine Co., Worcester, Mass.
Heldt, P. M., *Horseless Age*, New York City.
Hertner, John H., Rauch & Lang Carriage Co., Cleveland, Ohio.
Hertzler, John W., Bearings Company of America, Detroit, Mich.
Hess, Henry, Hess Steel Castings Co., Philadelphia, Pa.
Hewitt, Edward R., International Motor Co., New York City.
Hewlett, Van W., Jr., Woodmere, L. I.
Hinsman, Edward E., Reading Standard Co., Reading, Pa.
Hooker, Duncan C., Johns-Pratt Co., Hartford, Conn.
Hubbard, Harold D., Electric Auto Lite Co., Toledo, O.
Hubbell, Lindley D., Hartford, Conn.
Huff, Russell, Packard Motor Car Co., Detroit, Mich.
Hull, Robert C., Gould Coupler Co., New York City.
Humphreys, C. H., Dunellen, N. J.
Hutton, F. R., Automobile Club of America, New York City.

Jarosch, Franz J., Bearings Company of America, New York City..
Jehle, Ferdinand, Automobile Club of America, New York City.
Jennings, John J., New Departure Manufacturing Co., Bristol, Conn.

Kennedy, W. P., New York City.
Krarup, M. C., New York City.

Landau, David, Sheldon Axle Co., Wilkes-Barre, Pa.
Lapointe, Ralph R., Lapointe Machine Tool Co., Hudson, Mass.
Leland, Henry M., Cadillac Motor Car Co., Detroit, Mich.
Lentz, L. Edward, General Vehicle Co., Inc., Long Island City, N. Y.
Libby, Albion D., Splitdorf Electrical Co., Newark, N. J.
Lipman, C. E. L., Lipman Air Appliance Co., Beloit, Wis.
Lloyd, R. McA., New York City.
Longwell, Henry E., Westinghouse Air Spring Co., East Pittsburgh, Pa.
Lothrop, Marcus T., Timken Roller Bearing Co., Canton, Ohio.
Lowe, William V., Hess-Bright Manufacturing Co., Philadelphia, Pa.
Lucas, Charles J. P., *Chilton Company*, Philadelphia, Pa.

McBrair, Henry C., Middletown, N. Y.
McComb, Henry G., General Vehicle Co., Inc., Long Island City, N. Y.
McConnell, D. A., Lovell-McConnell Manufacturing Co., Newark, N. J.
McCreery, William B., Carnegie Steel Co., Pittsburgh, Pa.
McKinley, C. W., Willys-Overland Co., Toledo, Ohio.
McMahon, H. R., Standard Steel Spring Co., Coraopolis, Pa.

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McMullen, George C., Crane Motor Car Co., Bayonne, N. J.
McMullen, Roger B., Chicago, Ill.
McMurtry, Alden L., Sound Beach, Conn.
Machol, Morris R., Hydraulic Truck Sales Co., New York City.
Manson, Ray H., Garford Mfg. Co., Elyria, Ohio.
Marburg, Louis C., Marburg Bros., Inc., New York City.
Marburg, Theodore H., Marburg Bros., Inc., New York City.
Markland, George L., Jr., Philadelphia Gear Works, Philadelphia, Pa.
Marmon, Howard, Nordyke & Marmon Co., Indianapolis, Ind.
Marshall, W. C., Federal Sugar Refining Co., New York City.
Martin, Fred L., Sheldon Axle Co., Wilkes-Barre, Pa.
Martin, Harold M., H. C. & A. I. Piercy Contracting Co., New York City.
Mathews, John A., Halcomb Steel Co., Syracuse, N. Y.
Miller, James A., Miller Metal Work Co., Jersey City, N. J.
Miller, Walter H., George Automatic Roller Bearing Co., Hamilton, O.
Moorhouse, Alfred, Hudson Motor Car Co., Detroit, Mich.
Morgan, R. L., Worcester, Mass.
Morris, Albert W., A. W. Morris Co., Springfield, O.
Morse, F. L., Morse Chain Co., Ithaca, N. Y.
Moskovics, F. E., Nordyke & Marmon Co., Indianapolis, Ind.
Moskovics, George L., S. A. E. Office, New York City.
Mudge, R. B., Hayes Wheel Co., Jackson, Mich.
Murden, Herbert H., Knickerbocker Motor Truck Mfg. Co., New York City.
Myers, A. J., New York City.
Myers, Cornelius T., Detroit, Mich.
Myers, E. A., Pittsburgh, Pa.

Nadall, Berne, Stewart & Warner Speedometer Corp., Chicago, Ill.
Nesmith, R. H., Upper Montclair, N. J.
Newkirk, Walter M., William & Harvey Rowland, Inc., Philadelphia, Pa.
Nikiforoff, Boris N., Schenectady, N. Y.
Nilson, Lars G., Nilson-Miller Co., Hoboken, N. J.
Norris, George L., American Vanadium Co., Pittsburgh, Pa.
Norton, Walter W., Autocar Co , Ardmore, Pa.
Norton, Wm. T., Jr., Seldon Motor Vehicle Co., Rochester, N. Y.

Olsen, Thorsten Y., Tinius Olsen Testing Machine Co., Philadelphia, Pa.
Osburn, Harry G., National Metal Molding Co., Economy, Pa.

Page, V. W., Bristol, Conn.
Palmer, William H., Jr., Electric Storage Battery Co., Philadelphia, Pa.
Parker, C. W., Detroit, Mich.
Pawlett, Louis M., Bridgeport, Conn.
Perrin, J. G., Lozier Motor Co., Detroit, Mich.
Peterson, Gustaf, Carnegie Steel Co., Pittsburgh, Pa.
Phillips, F. F., Gibney Tire & Rubber Co., New York City.
Pierce, H. S., Link Belt Co., Philadelphia, Pa.
Pierson, F. B., National Lead Co., Detroit, Mich.
Poor, Frederic H., S. K. F. Ball Bearing Co., New York City.
Pope, Niran Bates, *Motor Trades Publishing Co.*, New York City.
Potter, Austin E., Brooklyn, N. Y.
Powers, L. W., New York City.
Pringle, Nelson S., Autocar Co., Newark, N. J.

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Prossen, Louis P., New York City.
Purdy, Frederick, Findeisen & Kropf Manufacturing Co., Chicago, Ill.

Queeney, Frank E., General Vehicle Co., Long Island City, N. Y.

Ranney, A. E., New York City.
Rippingille, E. V., Hudson Motor Car Co., Detroit, Mich.
Rockwell, W. D., Detroit, Mich.
Rodgers, Clarence M., Springfield, Mass.
Romeyn, Radcliffe, American Malleables Co., Owosso, Mich.
Rosenberg, Ralph H., Universal Machine Co., Bowling Green, O.
Rosenfeld, Maurice S., New York City.
Rosenfield, Julius, New York City.
Ross, Edward A., Ross Gear & Tool Co., Lafayette, Ind.
Ross, E. J., Edison Storage Battery Co., Orange, N. J.
Russell, R. F., Bessemer Motor Truck Co., Grove City, Pa.

Sargent, George Wm., Crucible Steel Co. of America, Pittsburgh, Pa.
Schaeffers, Joseph, Cleveland, Ohio.
Schatz, H. A., Schatz Manufacturing Co., Poughkeepsie, N. Y.
Scheel, Henry Van Riper, Brighton Mills, Passaic, N. J.
Schipper, J. Edward, *Class Journal Co.*, New York City.
Schmid, Martin H., United Steel Co., Canton, O.
Schneider, Louis J., Hyatt Roller Bearing Co., Detroit, Mich.
Schwarz, Charles L., Philadelphia, Pa.
Scott, Carl F., Sprague Electric Works, New York City.
Seeley, S. Ward, New York City.
Shailer, Robert A., Fahrig Metal Co., New York City.
Shain, Charles D., Brooklyn, N. Y.
Shamroy, N. J., New York City.
Slade, Arthur J., New York City.
Slauson, Harold W., *Leslie-Judge Co.*, New York City.
Slocum, Frank S., Fellows Gear Shaper Co., Springfield, Vt.
Snyder, L. H., Joseph Dixon Crucible Co., Jersey City, N. J.
Souther, Henry, Ferro Machine & Foundry Co., Cleveland, O.
Sowers, D. W., Sowers Manufacturing Co., Buffalo, N. Y.
Sparks, Wm., Sparks-Withington Co., Jackson, Mich.
Spicer, C. W., Spicer Manufacturing Co., Plainfield, N. J.
Stickels, E. H., Holt-Welles Co., Inc., New York City.
Stiger, C. W., Stromberg Motor Devices Co., Chicago, Ill.
Strickland, Wm. R., Peerless Motor Car Co., Cleveland, O.
Sweet, Ernest E., Cadillac Motor Car Co., Detroit, Mich.

Thomson, A. G., Joseph Dixon Crucible Co., Jersey City, N. J.
Tibbetts, Milton, Packard Motor Car Co., Detroit, Mich.
Towle, Herbert L., Philadelphia, Pa.
Towne, Thomas, New York City.
Trumble, John T., Chevrolet Motor Co., Flint, Mich.

Utz, John G., Perfection Spring Co., Cleveland, Ohio.

VanDervoort, W. H., Moline Automobile Co., East Moline, Ill.

Wall, William Guy, National Motor Vehicle Co., Indianapolis, Ind.
Warren, J. B., Philadelphia Steel & Forge Co., New York City.
Watts, F. E., Hupp Motor Car Co., Detroit, Mich.
Wells, F. O., Greenfield Tap & Die Corp., Greenfield, Mass.

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Whitbeck, J. V., Chandler Motor Car Co., Cleveland, O.
Whitman, Roger B., New York City.
Whitney, E. R., Commercial Truck Co. of America, Philadelphia, Pa.
Whittelsey, Charles B., Hartford Rubber Works Co., Hartford, Conn.
Whitten, Frrank Allen, General Motors Truck Co., Pontiac, Mich.
Wilkinson, John, H. H. Franklin Manufacturing Co., Syracuse, N. Y.
Williams, Louis W., Union Drawn Steel Co., New York City.
Wilson, Henry C., New York City.
Wilson, M. W. H., Cadillac Motor Car Co., Detroit, Mich.
Winkler, Aage E., Racine, Wis.
Wolf, Austin M., Twombly Motors Corp., New York City.
Woodbury, A. C., New York City.
Wulf, F. C., Gray & Davis, Inc., Boston, Mass.

Young, Conard H., Armstrong Cork & Insulation Co., Pittsburgh, Pa.

Zimmer, Richard R., Crane Motor Car Co., Bayonne, N. J.
Zimmerschied, K. W., General Motors Co., Detroit, Mich.

GUESTS

Ackley, C. S., New York City.
Alexander, H. S., Goodyear Tire & Rubber Co., Akron, O.

Barr, H. P., New York City.
Benjamin, H. L.
Borger, H. E.

Cannes, E., Public Service Commission.
Castle, F. H., Tate Brothers.
Coble, E. W.
Corbett, M. C.

Daly, E. F., Barthel & Daly, New York City.
Daly, T. J., Standard Woven Fabric Company.
†Diamond, James E., Aluminum Castings Co., Detroit, Mich.
Dixon, James.
Drysdale, K. P., Cadillac Motor Car Co., Detroit, Mich.
DuComb, W. C., Jr., Barthel & Daly, New York City.

Ellingham, R. W., Hendee Manufacturing Company.

Foster, A. S., Standard Roller Bearing Co., Philadelphia, Pa.
Fuller, R. B., Polytechnic Institute, Brooklyn, N. Y.

Golden, Asher, New York City.
Goodman, J. H., Garford Company.

Horstman, H.
Houston, H. S., Sheffield Scientific School.

Joy, H. M., Studebaker Company.
Judge, Franklin, Greenfield Tap & Die Co., Greenfield, Mass.

Kelly, F. J., Brighton Mills, Passaic, N. J.
Kiessewetter, H. M., Houk Manufacturing Co., New York City.

†Elected to membership since Annual Meeting.

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Lawler, M. M., New York City.
Lockwood, E. H.
†Loutrel, Cyrus H., National Lock Washer Co., Newark, N. J.

Machen, C. H., Standard Roller Bearing Co., Philadelphia, Pa.
Macon, W. W., *Iron Age*, New York City.
Marsh, W. L., Detroit, Mich.
Mawson, Robt., *American Machinist*, New York City.
Meredith, W. F.
Moldenke, R., Watchung, N. J.
Moore, T. J., Halcomb Steel Company.

Perry, A. M., *Electrical World*, New York City.
Pike, F. M., National Carbon Co., Brooklyn, N. Y.
Potosky, W. D., Black & Boyd, New York City.
Putnam, A. L., Detroit, Mich.

Reilly, E. J., Western Electric Co., New York City.
*Richmond, E. E., Elco Company, Bayonne, N. J.
*Ridlon, J. R., Locomobile Co. of America, Chicago, Ill.
Ronayne, G. J., Pope-Hartford Co., Hartford, Conn.

Schoenfuss, S. H., Standard Roller Bearing Co., Philadelphia, Pa.
Schram, A. J., Schram Motor Car Co., Seattle, Washington.
Smelling, Carl, New York City.
Snow, L. K., Cadillac Motor Car Co., Detroit, Mich.
Spooner, F. E., Spooner & Wells, New York City.
†Suttill, A. G., James Boyd & Bros., Philadelphia, Pa.
Sykes, Mr., Brighton Mills, Passaic, N. J.

Taylor, John B., New York City.
Temple, C. H.

Van Tine, H. A.

*Waite, E. E., Standard Woven Fabric Co., So. Framingham, Mass.
Warner, S. T., Public Service Commission.
Watkin, L. M., Jr., Standard Roller Bearing Co., Philadelphia, Pa.
Wernig, F. A., Flushing, N. Y.
White, D. McCall, Cadillac Motor Car Co., Detroit, Mich.
Wright, D. M., Hartford, Conn.

Yerger, F., Philadelphia, Pa.

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*Applicants for membership.
†Elected to membership since Annual Meeting.

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CHANGES OF ADDRESS OF S. A. E. MEMBERS

Ash, Charles S., formerly engineer and chief draftsman, The McCue Co., Buffalo, N. Y.; now chief draftsman, Houk Mfg. Co., Buffalo, N. Y.

Brockway, C. P., formerly mechanical engineer, Apple Electric Co., Dayton, Ohio; now sales manager, Recording & Computing Machines Co., Dayton, Ohio.

Clayden, A. Ludlow, formerly editor, **Automobile Engineer**, London, England; now engineering editor, **The Automobile**, New York City.

Connell, H. L., formerly technical editor, **The Light Car Publishing Co.**, Detroit, Michigan; now member engineering faculty, automobile department, Central Continuation School, Milwaukee, Wisconsin.

Dalton, H., formerly vice-president, Frevert Machinery Co., New York City; now president, Dalton Machine Co., Inc., New York City.

Jerome, Benjamin, formerly engineer, Couple Gear Freight Wheel Co., Grand Rapids, Michigan; now in engineering department, Cadillac Motor Car Co., Detroit, Michigan.

Kuehn, Geo. F., formerly chief draftsman, Bosch Magneto Co., Springfield, Mass.; now head of production drafting department, Rushmore Dynamo Works of Bosch Magneto Co., Plainfield, N. J.

McKenzie, D. M., formerly chief inspector, Kinsey Mfg. Co., Toledo, Ohio; now assistant chief inspector, Continental Motor Mfg. Co., Muskegon, Mich.

Maraini, Bernardino, formerly chief engineer, F. I. A. T. Co., Poughkeepsie, N. Y.; now chief inspector engineer, F. I. A. T. Co., Turin, Italy.

Mevis, Geo. A., formerly sales manager, Springfield branch, Packard Motor Car Co., Detroit, Michigan; now manager, Springfield branch, Stevens-Duryea Co., Chicopee Falls, Mass.

Mowe, John V., formerly manager, rim department, Goodyear Tire & Rubber Co., Detroit, Michigan; now assistant general manager, Kelly-Springfield Tire Co., Detroit, Michigan.

Owen, Ralph R., formerly general manager, C. A. Metzger, Inc., New York City; now connected with R. M. Owen & Co., New York City.

Patterson, James M., formerly vice-president, Patterson Rubber Co., Lowell, Mass.; now vice-president, Needham Tire Co., Charles River, Mass.

Planche, E., formerly chief engineer, Durant Dort Carriage Co., Flint, Mich.; now chief engineer, Dort Motor Car Co., Flint, Michigan.

Pringle, Nelson S., formerly engineer of tests, Autocar Co., Ardmore, Pa.; now manager, Autocar Sales & Service Co., Newark, N. J.

Stout, Wm. B., formerly editor, cyclecar department, **Motor Age and Automobile**, Chicago, Illinois; now chief engineer, Scripps-Booth Co., Detroit, Mich.

Waite, J. D., formerly factory manager, Stamping & Tool Co., La-Crosse, Wis.; now superintendent, Wilson Jones Loose Leaf Co., Chicago, Ill.

Walker, F. George, formerly sales manager and service engineer, Hartford Auto Parts Co., Hartford, Conn.; now Detroit sales office, Royal Equipment Co., Bridgeport, Conn.

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Wilcox, Forrest G., formerly president, Wilcox-Chandler Co., New York City; now general manager, Wilcox-Crymble Co., New York City.

APPLICATIONS FOR MEMBERSHIP

A list of current applications for membership is given below. The members are urged to send for the consideration of the Council any pertinent information with regard to those whose names are given which the Council should have prior to the election of any of the said applicants. It is requested that communications from the members in this connection should be sent promptly.

Campbell, Alfred L., Experimental Engineer and Designer, Brewster & Co., Long Island City.

Chesnutt, Ralph C., Chief Designer, Aurora Automatic Machine Co., Chicago, Illinois.

Coholan, William T., Salesman, The Stanley Works, New Britain, Conn.

Gould, W. S., Vice-president and General Manager, Gould Storage Battery Co., New York City.

Greer, Perry H., President, Greer-Robbins Co., Los Angeles, Cal.

Haines, William A., Salesman, Westinghouse Elec. & Mfg. Co., Detroit, Mich.

Jack, Robert K., Chief Engineer, Russell Motor Car Co., Toronto, Canada.

Jacobson, Hans O., Superintending Engineer and Machinist, Churchs Ferry, N. Dak.

LeMunyon, Ethan C., President, LeMunyon & Bidelman, Inc., Los Angeles, Cal.

Liston, Joseph H., District Manager, Thermoid Rubber Co., Trenton, N. J.

Maloney, John E., Sales Engineer, Hydraulic Pressed Steel Co., Cleveland, Ohio.

Rhoades, Lewis T., Electrical Engineer and Vice-president, New York Coil Co., New York City.

Richmond, E. E., Chief Engineer, Elco Co., Bayonne, N. J.

Ridlon, John R., Repair Department Foreman, Locomobile Co. of America, Chicago, Ill.

Waite, E. E., Chief Engineer and Factory Manager, Standard Woven Fabric Co., So. Framingham, Mass.

Welton, Spencer, Vice-president and General Manager, Rutherford Rubber Co., Rutherford, N. J.

Winther, Martin P., Truck Engineer, Thos. B. Jeffery Co., Kenosha, Wisconsin.

Young, Otto W., Designer, H. E. Wilcox Motor Co., Minneapolis, Minn.

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OFFICERS OF THE SOCIETY

President, William H. Van Dervoort, Moline, Ill.

First vice-president, Frederick R. Hutton, New York.

Second vice-president, Joseph A. Anglada, New York.

Treasurer, Arthur B. Cumner, New York.

Chairman of Finance Committee, H. M. Swetland, New York.

Secretary and General Manager, Coker F. Clarkson, New York.

MEMBERS OF THE COUNCIL

William H. Van Dervoort, Moline, Ill.
Frederick R. Hutton, New York.
Joseph A. Anglada, New York.
Arthur B. Cumner, New York.
Christian Girl, Cleveland, Ohio.
Henry C. Wilson, New York.
F. M. Germane, Philadelphia, Pa.
William P. Kennedy, New York.
C. B. Rose, Moline, Ill.
John Wilkinson, Syracuse, New York.
Howard Marmon, Indianapolis, Ind. (Past President).
H. M. Leland, Detroit, Michigan (Past President)

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SECTIONS OF THE SOCIETY

DETROIT SECTION

E. T. BIRDSALL.....*Chairman*
C. T. MYERS and W. N. OSBURN.....*Vice-Chairmen*
W. H. CONANT.....*Acting Secretary and Treasurer*

(Address) Kerr Bldg., Detroit, Mich.

Meets first Thursday each month at 8 p. m., in the Employers' Association Rooms, Stevens Building, Detroit, Mich.

INDIANA SECTION

LON R. SMITH.....*Chairman*
R. H. COMBS.....*Vice-Chairman*
CHAS. P. GRIMES.....*Secretary-Treasurer*

(Address) Wheeler & Schebler, Indianapolis, Ind.

Meets first Tuesday after first Wednesday each month at 8 p. m., at the Hoosier Motor Club in the Claypool Hotel, Indianapolis, Ind.

METROPOLITAN SECTION

JOSEPH A. ANGLADA.....*Chairman*
HERBERT CHASE.....*Treasurer*
NIRAN BATES POPE.....*Secretary*

(Address) 1790 Broadway, New York City.

Meets last Thursday each month, except July and August, 8 p. m., at the Automobile Club of America, 247 West Fifty-fourth Street, New York City.

CLEVELAND SECTION

JAMES H. HERRON.....*Chairman*
H. B. ANDERSON.....*Vice-Chairman*
A. J. SCAIFE.....*Treasurer*
R. J. NIGHTINGALE.....*Secretary*
E. R. HALL, J. H. HERTNER, R. H. MANSON.....*Members Board of Directors*

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APPLICATIONS APPROVED DURING JANUARY

MEMBERS

Blackburn, Samuel L., 1114 Swetland Bldg., Cleveland, Ohio.
Corse, William M., 106 Morris Ave., Buffalo, N. Y.
Diamond, James E., care of Aluminum Castings Co., Detroit, Mich.
French, Laurence E., 1047 Mt. Elliott St., Detroit, Michigan.
Loutrel, Cyrus H., care National Lock Washer Co., Newark, N. J.
Suttill, Albert G., 2813 W. Clementine St., Philadelphia, Pa.

ASSOCIATES

Badger, F. E., care of J. B. Armstrong Mfg. Co., Flint, Mich.
Tower, Edwin B. H., Jr., 1621 Fort Dearborn Bldg., Chicago, Ill.
Whitney, Chas. S., care of Westinghouse Elec. & Mfg. Co., Indianapolis, Ind.

JUNIORS

Pollitt, John, Jr., 9 Marlowe Road, Liscard, Cheshire, England.

AFFILIATE MEMBERS

Cincinnati Ball Crank Co., Cincinnati, Ohio; Representatives, Clifford Greene, Pres. and Treas.; A. B. Breeze, Vice-pres. and Gen. Mgr.; I. D. Shaw, Salesman.

Kalamazoo Spring & Axle Co., Kalamazoo, Michigan; Representatives, Chas. H. Gleason, Mech. and Designing Engineer; Thomas Grant, Production Mgr. and Engr.

STUDENT ENROLLMENT

Harlan, J. Allen, 532 Packard St., Ann Arbor, Michigan.

POSITIONS AVAILABLE

The following announcements are published for the information of members of the Society. No charge whatever is made for these announcements. Members who wish additional information will please address the office of the Society:

189. Foundry foreman; one who can handle men and knows foundry business, especially in the cast-iron line.

204. Salesman for New England States to look after local dealers. Must be high-grade man who can get results on commission basis. We have a proposition that appeals to all men of ability in selling line.

*205. Man competent to undertake charge of manufacturing department as superintendent. One who is a thorough mechanic, with executive ability; able to meet men and estimate on new work in the line of pressed steel manufacture.

(*Concluded on page* 8)

*Send written application to S. A. E. office to be forwarded to employer.

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Positions Available—Continued.

206. Electrical engineer experienced in electrical starting and lighting systems for automobiles. Must be capable of designing such apparatus, and have experience in ignition systems, if possible.

207. A man capable of directing or assuming charge of entire inspection, from receipt of raw material to final car inspection.

*208. Die sinkers, experienced in automobile drop forgings.

MEN AVAILABLE

0295. Engineer, having 16 years' experience in designing all parts of automobiles. Gas engine a specialty. Thirteen years in general manufacturing. Has been chief engineer of a large automobile factory for the past eight years. Will be open for a position Dec. 1st.

0296. Draftsman; eleven years' drafting experience, five designing commercial cars, high-grade and light pleasure cars. Can qualify as layout man, designer, checker or chief draftsman. Would prefer situation in middle west. Twenty-eight years of age.

0297. Designing and manufacturing engineer on medium-priced pleasure cars wants chance as works manager, engineer or superintendent. Fourteen years' practical and theoretical work. Technical graduate in mechanical engineering.

0298. Engineer-writer with long and varied practical experience as designer and constructor of trucks and pleasure cars and in editorial work with a number of trade papers, desires large opportunity in an advertising department, preferably with a firm building both cars and trucks. Write advertising, publicity, catalogs in English and Spanish, booklets, repair parts lists, instruction books, edit house organ, etc. Complete knowledge of printing, engraving, paper, type, etc. Eastern location preferred.

0299. Engineer with experience peculiarly fitting him for the service, desires position with leading company to act as point of contact between engineering department and the service, sales, advertising and publicity departments. Can handle mechanical instruction of salesmen, write instructive books and aid in experimental work.

0300. An active man wishes a position where twelve years' practical experience with carburetion and ignition troubles would be useful. Has been service engineer and in charge of shop and laboratory.

0301. A graduate of the Texknowlgic College (Russia) seeks a position as first-class draftsman or parts inspector with an automobile factory or automobile accessory concern in the Middle West.

(*Concluded on page* 8)

*Send written application to S. A. E. office to be forwarded to employer.

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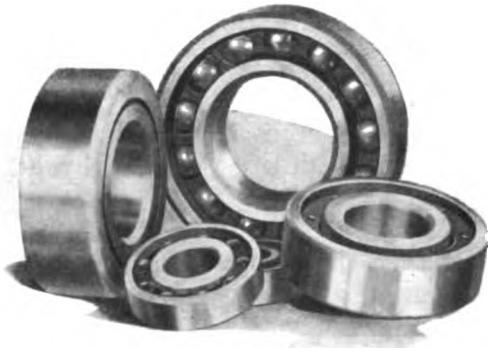
New Departure Ball Bearings

American Made for American Trade

THE demand for the Engineering Edition of our new Ball Bearing catalog quickly exhausted the supply.

The second edition of this valuable book is now ready —if you have not asked for one before, write today.

The New Departure Mfg. Co.
Bristol, Conn., U. S. A.
WESTERN BRANCH:
1016-17 Ford Building, Detroit, Mich.



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DEMONSTRATION

of

NATURAL FORCES

as applied in the

Browne Carbureter

at the recent Automobile Show in New York.

The injecting force on a fuel nozzle is made up of two factors:
Force (a), The vacuum created by the suction of the engine.
Force (b), The velocity of the air flow passing the fuel nozzle.

The demonstration successfully proved the sustained air/gas composition procurable through the Browne.

It conclusively proved the invariability of the action of the auxiliary valve in harmony with the variations of force (a) through the control of the combined forces (a) and (b).

As these forces act equally upon the fuel and the air nozzle (actuating the auxiliary air valve) a constant air/gas composition is maintained irrespective of atmospheric densities—through the action of the combined forces (a) and (b).

The water gauge registered the amount of air in cubic feet per minute through the Venturi throat.

A tachometer registered the r. p. m. of the motor.

The registrations on the gauge and the tachometer always corresponded at any given engine speed.

Corresponding deflections of the auxiliary air valve itself were plainly visible, harmonizing with the minutest changes in force (a).

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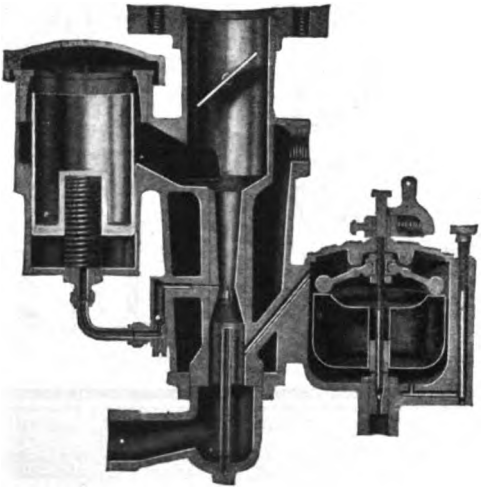

The one adjustment on the Browne (the fuel) permits of setting the needle to give the most explosive mixture.

There is nothing further to do.

All other conditions are met by the carburetor itself, into the design of which are incorporated curves and proportions which make it in operation superior to and unaffected by all barometric conditions.

Thorough investigation and severest tests of the Browne are genuinely welcomed.

Malleable Iron Fittings Co., Branford, Conn.

The Browne is made in a factory where thoroughness of workmanship and perfection of manufacture are distinguishing characteristics, and with unlimited facilities for the production of carburetors in quantities to meet possible requirements.

SOLE SELLING AGENTS:

Holt-Welles Company, Inc.

E. H. Stickels, President

U. S. Rubber Building **1790 Broadway, New York**

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HAYES WHEELS MEAN RELIABILITY

When the motor car builder entrusts his wheel requirements to us, he has settled two points of uncertainty:

(1) He will receive good wheels, wheels carefully built to his specifications, and built to give in full the service demanded of them.

(2) He will be assured delivery of these wheels in the quantities he wants them, and at the time he wants them.

"WE BUILD MANY, AND WE BUILD WELL."

Hayes Wheel Company

Jackson, Michigan

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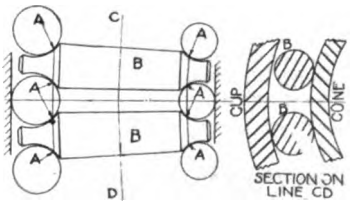
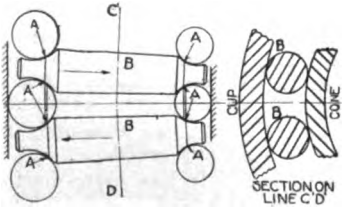
The Positive Automatic Adjustment of

THE GEORGE AUTOMATIC ROLLER BEARING

The tapered rollers of the GEORGE AUTOMATIC ROLLER BEARING have lateral freedom controlled by the contact of the balls at A on the conical ends of rolls B. Assuming in a roller of one-half inch diameter at the large end, a manufacturing variation of even .003", which is of course ridiculously high, the rollers will adjust laterally until the same working diameter on each is presented between the cup and cone.



A large and small roller (exaggerated) in contact with balls and raceways before automatic adjustment takes place.



After adjustment. The rollers have automatically adjusted themselves. Note how rollers B have moved in direction shown by arrows until they present the same working diameter to cup and cone.

When the bearings are mounted and tightened in place the rollers have not assumed their working positions; but with a half turn the pressure on the large rollers causes them to creep back, forcing the two balls in contact further apart. This pressure is equalized by other balls closing in on the smaller rollers at the large end, which forces them forward until all present the same working diameter between the cup and cone.

Other features of the GEORGE AUTOMATIC ROLLER BEARING will be described in later issues of the S. A. E. Bulletin.

THE GEORGE AUTOMATIC ROLLER BEARING CO.

Walter H. Miller, President **Hamilton, Ohio**

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Connecticut Automatic Ignition

CONNECTICUT AUTOMATIC IGNITION is without question the most modern and effective system of ignition thus far devised because—

The Connecticut Automatic Igniter delivers its hottest spark at the lowest motor speeds when carburetion demands a hot spark, and its high speed spark is as effective as the magneto's best effort.

It has absolutely no electrical or mechanical lag at any speed.

It has more perfect synchronism than the best magneto.

Its Automatic Switch makes it impossible to completely or partially run down the battery through accident, tampering, or neglect to throw it off.

The elimination of lag admits of extreme simplicity, obviating the necessity of compensating devices, which in turn destroy synchronism and make a sluggish motor, particularly on hill work.

The fact that the 8-cylinder Igniter will fire perfectly at a motor speed of 3000 R.P.M. as well as at the lowest speed at which it is possible to turn the motor over only goes to show its remarkable mechanical and electrical design.

We desire competitive service and dynamometer tests with any Ignition System built.

Made for 3, 4, 6 and 8 cylinder motors.

Catalog on Request

CONNECTICUT TELEPHONE & ELECTRIC COMPANY, INC.

MERIDEN - - - CONNECTICUT, U.S.A.

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ENGINEERS KNOW THAT

Breakage in iron or steel is due to distortion of crystals.

Frequently a series of little shocks will do the same damage as a heavy blow. Breakage is also caused by repeated bending beyond the elastic limit.

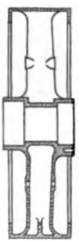
To the U spoke wheel (Fig. 1) two hundred and twenty tons were applied, and when released a spoke broke at "D."

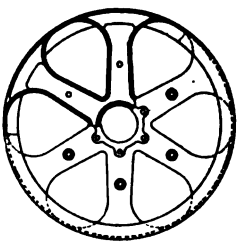
Imagine what will happen to the wheel which is not strong enough to resist shock at point "C" if parts "A" and "B" are bent back and forth over "C" as a fulcrum.

To distribute shocks over a large area is to minimize their force.

Road shocks can not be eliminated; therefore wheels should be DESIGNED to distribute their force over the whole circumference.

THE DAYTON STEEL WHEEL





The most resilient, lightest, strongest and most dependable wheel, point for point.

First: The narrow arch construction of hollow spokes and rim.

Second: The absence of dangerous joints between rim and spokes.

Third: The two flanges on the wheel rim not directly connected with spoke will distribute shocks freely and evenly over the entire wheel, making it a safe construction. The centrifugal force is less in the light channel section wheel than in the hollow rim wheel.

THE DAYTON STEEL FOUNDRY COMPANY

DAYTON, OHIO

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(Men Available—Con.)

0302. Electrical and mechanical engineer, 33 years of age, 12 years' experience, desires to make connection with some firm as electrical or mechanical engineer or superintendent. Also has selling experience.

0303. Managing and designing engineer of twelve years' experience in car and engine building, desires employment with automobile parts or automobile manufacturer, in the capacity of either sales promoter or production manager. Large acquaintance among dealers.

0304. Sales manager with fourteen years' experience in automobile accessory business, now employed by one of the largest manufacturers in business, is desirous of making a change for reason which will be given in an interview and which may be confirmed by investigation. Thoroughly experienced in selling, sales systems, office management and credit work. Capable of employing and handling salesmen and getting the best results. Thorough acquaintance with big buyers. Would become financially interested in concern if services prove satisfactory. With present concern five years. Age 35 years.

0305. Superintendent of a high-grade automobile engine manufacturing company desires to make change. Good organizer, producing at low cost. Best reason for leaving present position. Best references.

0306. Mechanical and electrical engineer. Capable and energetic, with excellent executive ability. Exceptionally good practical experience on both trucks and pleasure cars; in engineering, designing, purchasing, shop practice, construction and production. Especially competent on electric systems. Able to handle men and fully capable of assuming responsibility. Married. Age 33. Salary moderate.

Gray Iron Castings
Thousands a week can be turned out on your contract. Visit our plant and test the capacity and responsibility of our foundry and machine shop combination. We mold, grind, machine, assemble and inspect from blue print to finished product, all under one roof. Save the additional time, annoyance and cost of placing separate contracts. We solicit your patronage.
THE FERRO MACHINE & FOUNDRY CO
CLEVELAND, OHIO
FERRO

Automobile-Part STAMPINGS
Our Special Equipment enables us to turn out highest quality light and heavy sheet-metal stampings or drawings
G.P.&F. Service
KNOWING HOW SINCE 81
Write for estimates on gasoline tanks, Mufflers, Hoods, Clutch Cases, Covers, Joint Cases, Housings, Pans, Shells, Drums, etc.
Send samples or blue prints
Geuder, Paeschke & Frey Co.
1365-1700 St. Paul Av. Milwaukee, Wis.

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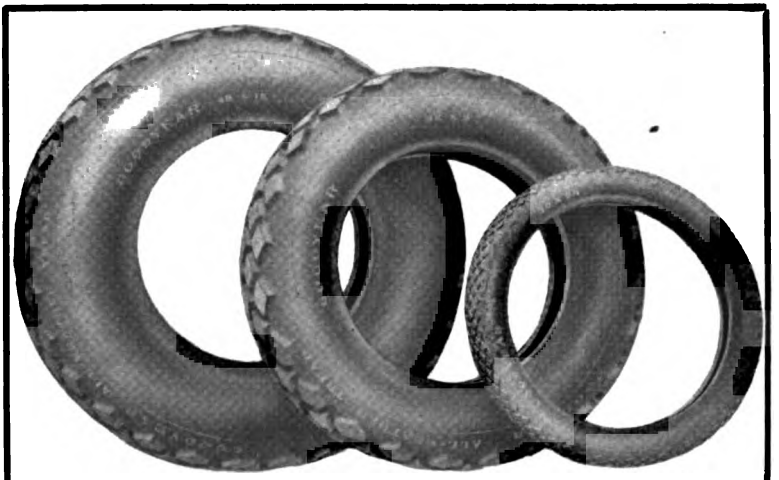

High-Speed Trucks Should Have Pneumatic Tires

Not only do such tires make possible higher speed, but they save money in the form of reduced wear and tear on the truck and its contents.

Large size pneumatic tires for trucks are a proven and eminently practical proposition. Even at low speeds they have great advantage on rough roads, and may be used all year 'round through rain and snow. Chains necessary only on wet ice.

We can furnish pneumatic truck tires (with All-Weather Treads) in the following sizes:

38x5½ in. 39x6 in. 38x7 in.
40x8 in. 42x9 in. 48x12 in.

Proper equipment for trucks (of normal size and with proper loads):

1-ton, 5½ in. front, 6 in. rear.
1½-ton, 6 in. front, 7 in. rear.
2 and 2½-ton, 7 in. front, 8 in. rear.
3 and 3½-ton, 7 in. front, 9 in. rear.
5-ton, 9 in. front, 12 in. rear.

We are also ready to figure on pneumatic equipment for still larger trucks.

Front wheels being usually the most sensitive to shock, pneumatic tires may be used on these alone in certain cases.

We Do Not Recommend Dual Pneumatic Tires

Experiment amply shows that a single large tire per wheel is much more satisfactory, both from a standpoint of application and use. The dual tire, although theoretically good on perfectly smooth roads, continually breaks down in practice, owing to one or the other tire carrying all the load over average ruts and bumps.

You are interested in keeping down truck repair bills. Write us. We have figures that will interest you.

GOODYEAR
AKRON OHIO
Pneumatic Truck Tires

The Goodyear Tire & Rubber Co., Desk 106, Akron, O.

Makers of Goodyear Automobile Tires

We make Demountable, Block, Cushion, S-V and Other Types of Truck Tires

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FILL OUT AND SEND TO S. A. E. OFFICE

SECRETARY,

SOCIETY OF AUTOMOBILE ENGINEERS,
1790 BROADWAY, NEW YORK CITY.
Please send application blank to

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NAME

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POSITION AND COMPANY

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ADDRESS

whom I consider eligible to S. A. E. membership.

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S. A. E. MEMBER

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ADDRESS

Date.....

DROP FORGED I BEAM FOR TORBENSEN ONE TON AXLE

WEIGHT 70 LBS.
Compare this Load Carrying Member of the
TORBENSEN INTERNAL GEAR DRIVE AXLE
with the Steel Castings used by other Systems of Final Drive. You will find a difference in our favor of over 300 pounds—nearly 20% of the Pay Load. Our design has many other equally valuable features.
TORBENSEN GEAR & AXLE CO.
224 High Street NEWARK, N. J.

We have to show service to get factory business.
Send for the proof.
See how we showed one manufacturer what Kelly-Springfield Tires have done and will do.

Kelly-Springfield Tire Company
Corner Broadway and 57th Street, New York
Branches and Distributors in All Principal Cities

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Due to our Cross Rolling process our steels are free from seams and pipes.

This is especially valuable in gear steels

Chrome Vanadium
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Forged **Cut**
Case Hardened **for** **Oil Treated**
Gears

Canton
Detroit **Chicago** **New York**

D. W. F. STEEL BALLS

Accurate to Within One Ten Thousandth of an Inch

FOR HIGHEST CLASS OF AUTOMOBILE AND MOTORCYCLE WORK, ETC. You cannot buy better balls than these for precision requirements. For ordinary use we recommend

BISMARCK STEEL BALLS

made of a superior grade of steel, perfectly hardened. First class finish and truly spherical.

Sole American Agents

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The NEW **KELLOGG** Engine Driven Fire Pump *A Selling Factor of Recognized Merit*

The Standard by which Other Pumps Must Be Judged

ALL METAL EVERLASTING CONSTRUCTION. A GUARANTEE AGAINST OIL SPRAY IN THE AIR. Good enough for the most expensive car. So reasonable in price that it can be included in the equipment of medium priced cars.

Write for Our Specifications

KELLOGG MFG. CO., Rochester, N. Y.

NEW YORK CHICAGO BOSTON DETROIT SAN FRANCISCO

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BIDDLE & SMART

CLOSED BODIES

A Production of the Highest Grade manufactured under exacting requirements.

The Biddle & Smart Company
AMESBURY MASSACHUSETTS

Automobile Wheels

High Grade—Best Made—Dry-Stock

HOOPES BRO. & DARLINGTON
(INCORPORATED)
West Chester, Penna. Write for prices.

CYLINDRICAL AND SQUARE MODELS
Standardize with us and save money
Janney - Steinmetz Co.

SEAMLESS STEEL LEAKLESS GASOLINE TANKS

Philadelphia

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BIJUR
MOTOR LIGHTING COMPANY
HOBOKEN, N. J.

Standard Equipment LIGHTING STARTING **on**

Winton

AND MANY OTHER CARS.

COMPETENT ADVICE ON PROPER TYPE, SIZE AND APPLICATION OF ELECTRIC STARTERS.

COMPLETE DESIGNS FURNISHED.

SEPARATE OR COMBINED UNITS.

ROME-TURNEY

The name stands for years of successful production of the highest grade Radiators.

Our wealth of knowledge and experience will solve your cooling problems. Simply ask us.

We make all types of Radiators, and **guarantee our product.**

WRITE US TODAY.

ROME-TURNEY RADIATOR COMPANY
Front Street, ROME, NEW YORK

The Standard Welding Co.
Main Offices and Factory: CLEVELAND
NEW YORK CHICAGO DETROIT

Stanweld Steel Tube Parts *for* the Motor Car Industry.

Drive-Shafts Steering Masts
Exhaust Tubes Muffler Pipes
Torque Tubes Manifolds
Robe Rails Cable Tubes

Stanweld Steel Tubing withstands every strength-test. It is light, strong, and has an exceptionally fine finishing-surface. No specifications are too rigid for our ability.

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Highest Grade Steel Balls Aplenty

Homogeneous, hard-clear-through steel balls, guaranteed absolutely accurate within *one ten-thousandth* of an inch and made right here in America

Atlas Steel Balls

Interesting Booklet for Your Address

Atlas Ball Company
209 Glenwood Ave., Philadelphia

Atlas Ball Company-Philadelphia

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REG U S PAT OFF

RAYNTITE TOPS

GUARANTEED ONE YEAR
(We Really Mean This)

Single and Double Texture. By actual test no advertised top material is better. Washable, grease-proof, and not affected by heat or cold. Samples FREE.

DU PONT FABRIKOID COMPANY
WILMINGTON, DEL. **TORONTO, ONT.**

A new booklet; pocket size; informative; shows how, when and where to use

DIXON'S GRAPHITE AUTOMOBILE LUBRICANTS

Sixteen pages and cover; fully and practically illustrated; sent free upon request. Mention No. 95-G.

Made in JERSEY CITY, N. J., by the
JOSEPH DIXON CRUCIBLE COMPANY

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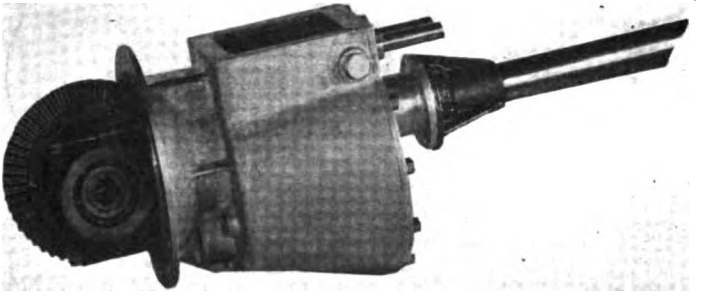
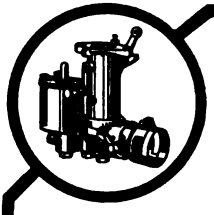
TRANSMISSIONS REAR AXLES

"From Fly Wheel to Drive Wheel" we furnish light-car builders with complete live units—either cone or dry disc clutch—three-speed transmission for unit power plants—special patented universal joint and standard type rear axle—bevel gear differential—double brakes. These designs are adaptable to any motor and rear end construction. Send a postal for "Transmissions Rear Axles"—an interesting booklet.

AMERICAN DIE & TOOL CO., Reading, Pa.





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Gentlemen: I have used your Red Head Plugs in my Model "H" Regal Underslung of 35 H.P. from August 1, 1912, until April 1, 1914, during which time I have driven over 35,000 miles with the same set of plugs. The body and the porcelain of the plug showed absolutely no wear. The only part which showed wear were the firing points which were worn down thin. I conside this a very remarkable showing.

TRIO MANUFACTURING COMPANY

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BALL BEARINGS

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Manufacturers of Automobile Wheels
Both Pleasure and Commercial Cars

STEERING CONNECTIONS
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Simple in construction and efficient

Complete Brake Rod Assemblies
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of a new design are being built by the

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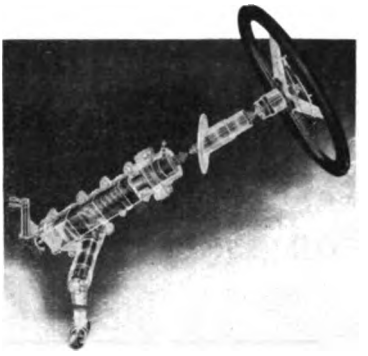

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FOR TRUCKS AND PLEASURE CARS

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CONNECTING ROD BROACHING

Closer Accuracy, Increased Production
When Handled by Our Method, and on

LAPOINTE BROACHING MACHINES

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Largest Manufacturer of Automobile Tops in the United States.

Quantity Production means Up-to-date Equipment, Prompt Delivery and Low Prices.

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MANUFACTURERS OF

GUARANTEED FORGINGS

The use of a Wyman & Gordon guaranteed forging means "Safety Always."

If you will allow us to cooperate with you our experience may enable us to save you money and trouble, as we have been able to do in many cases.

American Axles

Pioneers in Chain Drive, Bevel Drive, Worm Drive and Spiral Bevel. And now farther in the lead than ever before with a new

FULL FLOATING AXLE

Equipped with Spiral Bevel Gears and Bock Taper Roller Bearings

Write for Particulars.

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The American Ball-Bearing Co.,

CLEVELAND, OHIO

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Ignition—Lighting—Starting

The quality and good service of the electric system on these cars can be relied upon; it's Westinghouse—read the list:

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Atterbury	FIAT	Marion	Richard
Auburn	Glide	Moreland	Seagrave
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- Shafting
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AIR TESTING MADE EASY

The operation of testing the air-pressure in tires having been found on occasion difficult and irksome by reason of the jamming together of the valve stem and dust cap, the firm of A. SCHRADER'S SON, Inc., have designed and placed on the market a new "Quick-Acting" dust cap which can be removed from the valve stem by a simple quarter turn.

The new SCHRADER "Quick-Acting" dust cap eliminates the work of screwing the cap down the entire length of the valve stem to the felloe of the wheel. All that is necessary is to slip the cap over the valve and turn it one-quarter turn. This locks it securely to the valve stem. To unlock, simply give one-quarter turn in the opposite direction. The locking device is composed of a thread made up of four sections. By pressing the dust cap against the rim nut the four sections contract into one continuous thread. When the cap is not in use the four sections are expanded so that the diameter is larger than the diameter of the valve stem.

YOU CAN NOW TEST THE AIR PRESSURE IN YOUR TIRES WITHOUT EFFORT.

The Schrader Universal Tire Pressure Gauge has been endorsed by Tire Manufacturers as the most reliable tire pressure gauge on the market.

Price, One Dollar

For sale by Tire Manufacturers, Jobbers, Dealers, Garages, or

A. SCHRADER'S SON, Inc.,
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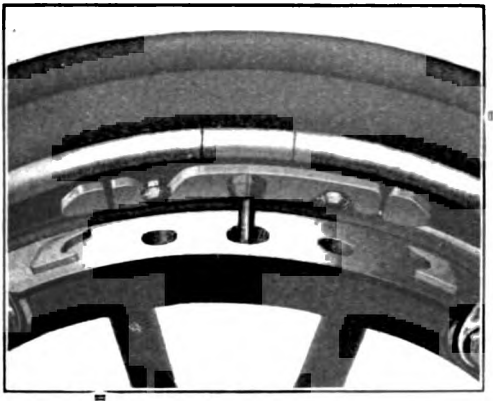

The Detroit Demountable Rim

The Rim that is Conclusively Mechanical

The arrow and "V"-block driving construction makes the Detroit Rim absolutely positive, and is the only demountable rim having this unique feature.

The cutout section of the Detroit Rim allows such freedom of operation in removing the tire that a pair of ordinary hands are the only tools—in extreme cases a small screw-driver is all that is necessary.

We claim for the Detroit Rim: strength, lightness, quality, economy and durability—a rim any novice can operate without the assistance of the "nearest garage."

We respectfully request the builders of motor cars to extend the opportunity of proving the worth of the above claims. Our prices are as interesting as our rim.

Jackson Rim Company

Jackson, Mich.

Exclusive Manufacturers of the Detroit Demountable Rim

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98%

of all the wire wheels displayed by car manufacturers at the recent New York Show were

HOUK
Detachable
Wire Wheels

Houk Manufacturing Co., Buffalo, N. Y.
1792 Broadway, N. Y. 2337 Michigan Ave., Chicago

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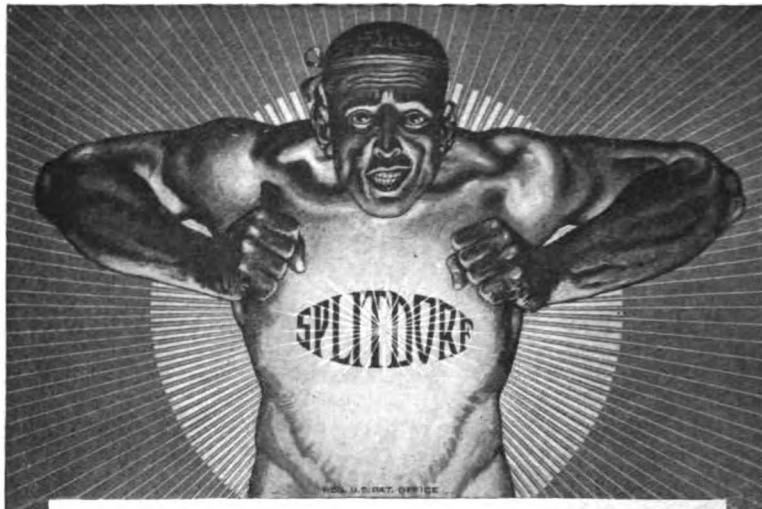

Largest MAGNETO Contract Ever Placed

OVERLAND ignition for 1916 will be exclusively DIXIE

The Willys-Overland Co. has placed the largest magneto order ever given

For their entire 1916 output

Not battery ignition—not 19th century magneto, but the 20th century DIXIE

SPLITDORF ELECTRICAL COMPANY

NEWARK, N. J.

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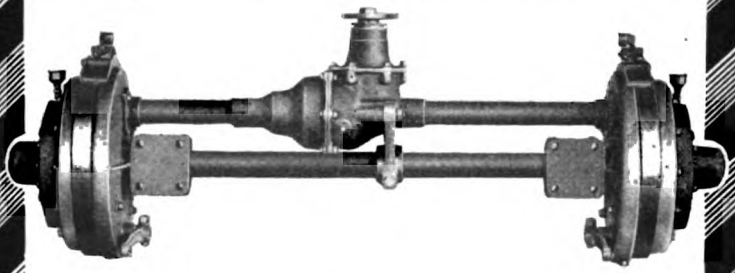
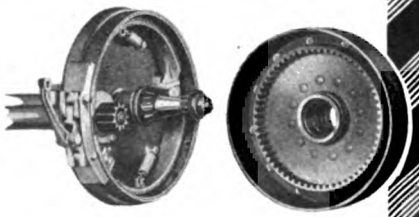
Russel

Internal Gear Drive Axle for One Ton Truck



FOR over a year our Engineering Department has concentrated its entire attention on the development of the one ton truck axle. Our investigations and tests have shown us the strength and weakness of the various rear drive systems now in use. The logical result has been the development of the one ton axle announced herein. We believe it represents the most serviceable compromise between the conflicting demands of durability, efficiency, quietness, simplicity, neatness and cost.

RUSSEL MOTOR AXLE COMPANY
North Detroit
· Michigan ·



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Three Years Later

The appearance and behavior of a new car may perhaps make present sales, but the efficiency after three or mote years of service makes its real reputation and gives a true indication of the value of the car.

The consistent use of

TEXACO MOTOR OIL

reduces wear, saves bearings and considerably lengthens the useful life of the car.

J. A. BEL LUMBER COMPANY, LTD.
Moeling P. O., La., Nov. 17, 1914.

The Texas Company,
Lake Charles, La.

Gentlemen:

Today my Hudson 33 Roadster is three years old, and have never had the valves ground, or any part of the engine worked on, except cleaning of plugs once.

I have used your Texaco Motor Oil and Gasoline on this car altogether, and have saved an average of ten dollars per month on garage bills, and know your oil is the cause of it.

Sincerely yours,
(Signed) ERNEST S. BEL.

The manufacturer who recommends Texaco Motor Oil increases the service derived from his car. This is a thought worth digesting.

THE TEXAS COMPANY
NEW YORK *Department "S"* HOUSTON
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Wagner Quality

THE STERLING MARK OF THE ELECTRICAL WORLD

When you go to a custom tailor for a suit, he first takes your measure. From these specifications the garment is cut. Then the tailor makes the suit according to the cut of the cloth. This done, you have a preliminary "try on." Very much the same operations are followed in making the

WAGNER STARTER
The Starter that is built to order

First, the exact measure of the engines' cranking requirements, under all conditions, is scientifically taken. Specifications are then figured and working drawings are made. The starter is built from these. The result is a perfect fit—a starter exactly suited to the car for which it was made.

The Wagner Company will be glad to send an experienced engineer to discuss with you the desirability of having a Wagner Starter designed and built for the car you are building.

Wagner Electric Manufacturing Co.
St. Louis

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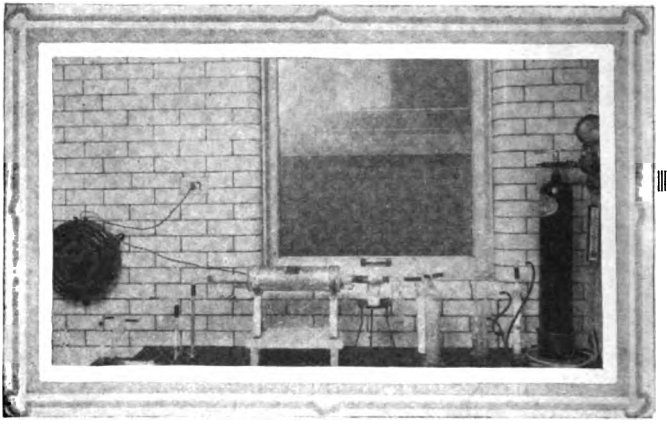

In chemical Laboratory of The Perfection Spring Company, depicting Johnson apparatus for determining carbon contents in steel.

Mistakes Only Waste Money.

OUR LABORATORY ELIMINATES SOME MISTAKES

The Perfection Spring Company
Cleveland, Ohio

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VOL. VII NO. 5

S·A·E BULLETIN

FEB. 1915

STANDARDS COMMITTEE PERSONNEL

ADMINISTRATIVE COMMITTEES

SUMMER MEETING DATES

DISCUSSION OF DIVISION REPORTS

MESSAGE FROM THE PRESIDENT

COMMERCIAL HEAT TREATMENT

SOCIETY OF AUTOMOBILE ENGINEERS
1790 BROADWAY · NEW YORK

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SAE BULLETIN

VOL. VII FEBRUARY, 1915 NO. 5

Published by the Society of Automobile Engineers
1790 Broadway, New York

WILLIAM H. VAN DERVOORT, President. COKER F. CLARKSON, Secretary.
ARTHUR B. CUMNER, Treasurer.

Issued monthly, 50 cents a number, $5.00 a year; to members 25 cents a number, $2.50 a year. Entered as second-class matter, August 27, 1914, at the post office at New York, New York, under the Act of August 24, 1912.

STANDARDS COMMITTEE FOR 1915

In accordance with the custom to revise annually the personnel of the Standards Committee, the Council at its last meeting made appointment of members of the Standards Committee, for the year of President William H. Van Dervoort's administration, as shown hereinafter. It will be noted that there have been newly created the International Standards Division and the Chain Division. The following Divisions have been discontinued for the time being: Aluminum and Copper Alloys Division, Broaches Division, Commercial Car Wheels Division, Data Sheet Division, Motor Testing Division and Standards Exchange Division. The Commercial Car Wheels Division has been combined with the Truck Standards Division. The activities

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which the Data Sheet Division has maintained will be continued at the office of the Society in conjunction with members especially well informed on the various subjects treated. The unfinished matters which the Standards Exchange Division has had in hand will be taken up by the Miscellaneous Division. It is felt that the work of other Divisions which have been discontinued is finished for the present at least.

The function of the International Standards Division is to promulgate the standards of the Society internationally and to formulate and assist in formulating recommendations as to international standards relating to the design and construction of motor vehicles. The car elements concerning which discussion has arisen in this connection are pneumatic and solid tires, particularly the latter. Past-President Leland pointed out at the last meeting of the Standards Committee the difficulties involved in American car manufacture owing to the difference in the European and American standards of pneumatic tire rims. The subject of interchangeability of solid tires on American and European rim standards has become more or less acute recently.

It is not known what progress can be made in harmonizing internationally the practices mentioned and it is appreciated that there are many difficulties involved in this connection. The Division is made up of members of the Society resident in various countries. The purpose of such a widely distributed membership is to assist in the collection of necessary data and the handling of the same.

The Council has established the Chain Division in pursuance of the resolution passed at the last meeting of the Standards Committee to the effect that it is desirable to have a committee endeavor to formulate a standard tooth form for silent chains.

Karl W. Zimmerschied, Past Vice-president of the Society, will serve as Chairman of the Standards Committee during the year. The Council has now under consideration the procedure to be observed in the formulation and adoption of recommended practices, with a view to improving the merit and efficiency of such procedure so far as possible.

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ADMINISTRATIVE COMMITTEES

President Van Dervoort has announced the appointment of members of the Administrative Committees for the year, as follows:

FINANCE COMMITTEE

H. M. Swetland, *Chairman*

A. L. Riker
L. B. Brown
Hermann F. Cuntz
Christian Girl

MEETINGS COMMITTEE

Robert McA. Lloyd, *Chairman*

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J. G. Perrin
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Ferdinand Jehle

MEMBERSHIP COMMITTEE

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H. E. Coffin
H. W. Alden
William Gray
R. B. Whitman

PUBLICATION COMMITTEE

F. R. Hutton, *Chairman*

Herbert Chase
C. T. Myers
W. G. Wall
R. C. Carpenter

NOMINATING COMMITTEE

It will be recalled by the members that a new method of designating the members of the Nominating Committee is provided for in the Constitution as revised last August. In the past the members of the annual nominating committees have been appointed by the Presidents of the Society during the respective years. Beginning with this year, the Nomi-

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nating Committee will be elected at meetings of the Sections and of the Society, in the manner set forth in the following paragraph of the Constitution:

C 46. The Nominating Committee shall consist of seven Members, and be elected annually. Four members of the committee shall be elected at the business session of the Semi-Annual meeting of the Society preceding the Annual meeting at which officers are to be elected. The three Sections of the Society having the largest membership shall each elect one member of the committee, prior to the respective Semi-Annual meeting of the Society.

The elections, as stated, will accordingly be held prior to and at the Semi-annual or Summer meeting of the Society to be held next June.

MESSAGE FROM THE PRESIDENT

I am glad and proud of the fact that I am a member of the engineering fraternity. I wish I had the command of words requisite to express how fully I appreciate the honor conferred upon me by election to the Presidency. I want to assure the members that it will be my effort to use every possible opportunity to further the interests of the Society. I appreciate fully that there is big work ahead, as well as that a great deal has been accomplished already. To follow as able a man as Mr. Leland in the Presidency is not easy. I can never hope to accomplish as much as he has been able to accomplish as President. I will do the best I can, however, to come up as nearly as possible to his standard.

The bulk of the attainments that will be had during the coming year will be due to the Officers, the Councilors, and the Committees that will be appointed. The merit of the work of an institution like the Society depends principally upon the co-operation of the members as a whole, but very largely upon what the Committees do.

I feel that the future of the Society is a great one. I can see no reason why the automobile engineers should not advance their art and science a great deal more in the future. In a way we have all specialized. Many of us, among the older members of the fraternity, at least, started in in general lines of engineering, at a time when, for instance, in

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the design of high-speed steam engines the question was not how little material could be put into the engine and the necessary strength and results maintained. We were, in fact, after rigidity, not strength. In the case of the automobile, the design of the motor and of all the parts requires the closest possible calculation. It is always a question of maximum power and maximum strength with minimum weight. This involves many difficulties. The growing demand for lighter-weight cars, for cars more active on the road, necessarily means that we must study reduction in weight.

I was very much interested in President Leland's address, and especially in some of the points he brought out. He dreamed of the possible future of the Society, what the outcome is going to be for those who are devoting their lifework to automobile engineering. I am strongly impressed by his judgment that the automobile engineers will increasingly divide their efforts between design engineering and production engineering. I feel that production engineering will, in the future, command a very large percentage of the attention of the members. The manufacturers of automobiles have not appreciated or solved the finest points of economical production. Competition is, however, bringing those points rapidly into the foreground, and we find that certain parts which have been manufactured in an extravagant way in the past are gradually being brought down in cost. It is not at all surprising today to find some component automobile part reduced in cost 100, 200, yes, 500 per cent. from the cost of a few years ago. It really seems that there is no limit to such reduction. The machine tool builder produces for us a machine that will make a certain part at a certain cost, which is much lower than it has been before. No sooner has he accomplished that than he immediately starts in to build another machine that will again cut the cost in two; and so it goes on. I believe that the engineer who devotes a considerable amount of his time, talent and energy to production work is going to have a very large field of operation available to him. If, as has been suggested, the manufacture of automobiles is to become centered in a comparatively small number of plants, the advantage of knowledge of production will be even more pronounced than it is at the present time.

WILLIAM H. VAN DERVOORT.

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SUMMER MEETING

June 14-17

The Summer meeting of the Society will be held on board a vessel leaving Detroit on the afternoon of June 14, for Georgian Bay, in and about which a cruise will be made, returning to Detroit on the afternoon of Thursday, June 17.

Detail arrangements, of which the members will be furnished advices promptly, are now being made with the assurance that the trip planned is, on account of the scenic features, the most attractive possible for the Society, so far as enjoyment is concerned.

The vessel selected for the outing is the S. S. *Noronic*, the flagship of the Northern Navigation Company's great fleet of steamers. The *Noronic* is 385 feet overall, and has a hull and six decks of solid steel. She carries an unusually powerful wireless telegraph system.

The Committee has reported that the steamer is luxuriously appointed, and could not be better suited to the needs of the meeting if it had been specially designed for the purpose. The adequacy of her dining room and galley is good to contemplate. The portion of the boat in which the technical sessions, of which there will be five, will be held, is spacious and suitably adapted to the orderly and satisfactory conduct of the sessions.

Each stateroom has an individual radiator, hot and cold running water, and berth reading lights.

The wide promenade extends completely around the vessel, six laps to the mile.

The officials of the line and the Meetings Committee are working hard to provide the most successful and instructive vacation and technical meeting trip the Society has had. Every effort will be made to meet the needs and wishes of the members, who are asked to co-operate to make the meeting as creditable and enjoyable as possible, a red-letter meeting which will have to be extremely good to surpass the best the Society has held.

The trip will be similar to those conducted by the Society during the summers of 1912 and 1913, but a different and justly famous region of the great fresh-water seas will be visited.

The members are requested to send inquiries and suggestions as to the trip to the New York office of the Society.

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STANDARDS COMMITTEE MEETING

Held at the Society Rooms, January 5

The meeting was called to order with Vice-president Zimmerschied in the chair.

ELECTRICAL EQUIPMENT DIVISION REPORT*

FUSES

C. W. McKINLEY:—I notice that nothing is said in the report concerning the glass-enclosed fuse, which is used to a considerable extent. I believe that it would be advisable to recognize that also as a standard.

JOSEPH BIJUR:—It was our intention to recognize the glass fuse and the dimensional specifications given in the report cover this type.

CHAIRMAN ZIMMERSCHIED:—It is not the policy to mention any one special device by name, single it out that way; if it meets the specifications it will meet the approval of the engineers.

C. W. McKINLEY:—I believe that the glass fuse is much shorter than those specified in the report. It is only about ½" to ¾" long.

JOSEPH BIJUR:—The Electrical Equipment Division considered the fact that there were a good many sizes of fuses. Upon investigating the sizes and differences it was found that the two sizes specified were by far the most popular, and in order not to have too many sizes it was agreed to recognize those two sizes only, the one recognized in our report last year and the other found to be most popular. We had to specify either two or something like eight. We thought that two series of dimensional specifications would make a good standard.

D. C. HOOKER:—The glass fuse to which Mr. McKinley referred has a tube diameter of about 3/16" and the diameter of the contact caps is ¼"; in other words, its diameter is the same as that of the smaller of the two fuses specified in the Division's report. But the length is only one-half as great. One point which I think ought to be brought out in this connection is that it is practically impossible to properly calibrate these very small fuses; the dimensions are so small that it is extremely difficult to secure an accurate rating. In fact, it would be impossible to make a fuse in these dimensions having the capacities and ratings embodied in the report. I think that the fuses which the Division suggests are by far the most practical from the

*For text of report see January, 1915, BULLETIN, page 220.

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fuse manufacturers' standpoint of any of the many different sizes now in use.

CHAIRMAN ZIMMERSCHIED:—We seem to be confronted with the situation that this article is in wide use at the present time. Shall we accept the presented set of fuse contact or clip dimensions, thereby asking manufacturers of this particular fuse to make it in a suitable size if they want to fit standard equipment? Or shall we increase the number of standard fuse bases to accommodate this product? Shall the Standards Committee indirectly accept the practice or principles which this fuse represents now as standard, or shall they force the manufacturers, if they can force them, to change their product to conform to the committee's views? Such action is inadvisable unless there are incontrovertibly strong technical reasons for taking it.

JOSEPH BIJUR:—My understanding is that the glass fuse as now made does fall within these specifications. If it does not do so there will probably be a question as to its rating with some particular portion of the standard requirements which we advocate adopting. If there is a difficulty for the glass fuse manufacturers to contend with, we are not so informed at present. The glass fuses are intended, as far as I know, to meet these specifications, because they are the specifications in use by the electrical trade.

W. G. WALL:—Quoting from the report, "Fuses must be of the enclosed type, constructed so that inspection can show whether or not they have been melted." That means, I suppose, that they must be either in glass or mica or something of the kind. Do they give good service when enclosed in glass? It has been my experience that they are rather liable to break. Mica is better. Glass enclosed in fibre or some material of that kind also gives better results.

JOSEPH BIJUR:—The words were not meant to cover only the transparent fuse. It was assumed that the indicator employed on the indicating non-transparent fuse is the means by which the fuse would be inspected to see whether it had been melted. We did not want to use the word "blown" because it was not as proper a word to use as "melted."

A. L. MCMURTRY:—If the small glass fuse of high capacity, say 20 amperes, is placed in a horizontal position, it is possible to have the circuit closed by the melted fuse. This trouble is abated by placing the fuse in a vertical position. It is also delicate work to replace glass fuses in tight clamps without damage to the fuse.

CHAIRMAN ZIMMERSCHIED:—The answer to that is the fact that a large number of them is in use. If in their particular sphere they seem to find a strong clientele among the engineers, we ought to make our specifications such that they can be used if desirable.

D. C. HOOKER:—One of the most important considerations in standardizing fuses is the determination of their electrical ratings.

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That has been covered very well in the report, wherein the same factors of maximum continuous current capacity, overload and blowing time interval are specified, as has been adopted by the National Board of Fire Underwriters for regular national standard fuses. But the whole purpose of that standardization will be defeated if dimensions are standardized which are inconsistent with established electrical standards and hence cannot be followed by the fuse manufacturers.

With the fuse that is 1½" long and ⅜" in diameter, it should be possible to conform to the ratings recommended with comparative ease. With the fuse that is 1¼" long and ¼" in diameter, it would be possible but very difficult. But with the small size, ⅝" by ¼" in diameter, recognition of which is being urged from the floor today, it would be absolutely impossible to make a 30- or even a 20-ampere fuse which would conform with these specifications. Such very small fuses ought to be eliminated from consideration or else the ratings ought to be so modified as to bring them within the possibilities of the dimensions. I do not wish to attempt to dictate what sizes of fuse shall be adopted or what electrical standards shall govern their calibration. That has been very well covered in the present report. What I wish to point out is the fact that if the fuse manufacturers are to serve faithfully the automobile trade, the standards adopted by this Society should be within the physical limits of practical manufacture.

CHAIRMAN ZIMMERSCHIED:—In case the question should arise as to which specification should be followed, the one in regard to size or the one in regard to rating, the rating specification would have to be followed, regardless of the size of the fuse. If it met the requirements as to size and did not meet the requirements as to rating, it certainly would not be an acceptable fuse.

JOSEPH BIJUR:—In connection with that there may be a misunderstanding that the largest rating must be used with the smallest fuse. That was not the intention. We recommend the size of fuse to be one of two sizes. When ratings are used they should not be ratings such as as 7, 9 and 11, but should be confined to 10, 20 and 30. If a man has to make a 30-ampere fuse he may make it of the larger size if he wishes. That is the intention of the report.

A. H. EHLE:—I would like to ask why there is any necessity for fixing a maximum size.

JOSEPH BIJUR:—We were informed that the larger size is sufficient for a 30-ampere fuse. If that is so, more than two sizes are unnecessary.

CHAIRMAN ZIMMERSCHIED:—Is there any other discussion on any point? If not, a motion would be in order to accept this report and adopt it as of the Standards Committee for presentation to the Council, with a view to its presentation to the Society as a whole.

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E. S. FOLJAMBE:—I move that the report be adopted.
(The motion was seconded, put to a vote and carried.)
(Vice-president Wall assumed the chair.)

FRAME SECTIONS*

CHAIRMAN WALL:—The report of the Frame Sections Division is certainly very comprehensive. I think that the Division deserves considerable credit for preparing it in so much detail. There is no question that detailed specifications of this kind are an excellent thing.

J. G. PERRIN:—Mr. A. L. Riker has written a letter suggesting that there be included in the list giving the amount of drop between top of side rail and front spring bolt center, a 6″ side rail, calling for a drop of from 6½″ to 7″. I think that is a very good point myself. A number of 6″ side rails are being used now.

The whole idea was to try to strike a composite of the different proportions used, so that there would be some chance for the frame makers carrying some tools in stock from which could be built up almost any possible design. And from canvassing the frame makers I believe this report coincides as nearly as possible with their present practice.

E. S. FOLJAMBE:—I suggest that the report be adopted, with the addition of a 6″ member with a 6½″ to 7″ drop between top of side rail and front spring bolt center.

(The report was amended in accordance with the suggestion.)

W. M. NEWKIRK:—As I understand it, these recommendations cover only frames for elliptic, semi-elliptic and platform springs. The cantilever spring requires a radically different frame, I think.

CHAIRMAN WALL:—It will require a somewhat different frame, as the strains are certainly different with a cantilever than with either a half elliptic or three-quarter elliptic spring. There is a question whether the committee have taken this into account.

J. G. PERRIN:—Yes, that question has been raised, but it was thought hardly advisable to attempt the collection of any definite data at this time. A man who is using a certain depth of frame now for semi-elliptic springs, say a 5″ frame section, will probably be forced to the 6″ section for the cantilever. That takes care of the additional strain in one direction, and of course in the other directions the strains are taken up either by increasing the width of the flange or by reinforcing the cross members. There is no attempt made here to specify the width of frame flange except as to a normal section. So in the width of the flange, in the installation of cross members

*For Report of Frame Sections Division see January, 1915, BULLETIN, page 224.

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and in the additional depth of the frame sections there are avenues open for meeting the cantilever spring situation.

C. E. DAVIS:—I suggest that the report of the Division be adopted as covering present development, subject to amendment by the Division when designs including cantilever springs are adopted.

(The motion was amended in accordance with the suggestion.)

(The motion was seconded, put to a vote and carried.)

LOCK WASHERS*

E. H. EHRMAN:—Lock washers suited to fillister or button head machine screws are equally well suited to hexagon head screws of the corresponding body sizes. In other words, a washer that could be used under the type of machine screw having a head of the smallest diameter would be suitable for use under a style of head of larger diameter. The case has a parallel in lock waashers ¼" and larger; these are made for use under U. S. S. nuts so that one type of washer answers for nuts of more than one outside dimension. For this reason I believe that one washer for each size machine screw would be adequate.

C. H. LOUTREL:—In connection with the size of lock washers, our plan in presenting the report on this matter was to get an idea from the machine screw makers as to how machine screw heads vary and then to do exactly what Mr. Ehrman suggested, design a lock washer which would meet the demands of all the sizes of head.

It might be well to say a word as to why the question of specifying material in lock washers was dropped. I was fortunate enough to be allowed to meet the committee and explain the way in which the railroads have been specifying lock washers. They adopt a similar practice to that in use in specifying railway springs. They ask the manufacturer to produce an article to a specific requirement when finished rather than tell him of what it shall be made. It was with that idea in view the Lock Washer Division recommended that no change be made in the S. A. E. standard. At a meeting held previously the question came up whether the chemical composition should not be specified or else some of the physical properties. It was finally decided that in all probability the manufacturer, if he had to meet a given physical specification in the finished goods, would provide a better article than if the chemical composition of the material were specified.

(Upon motion, duly seconded, the report was accepted as one of progress.)

*For progress report of Lock Washer Division, see January, 1915, BULLETIN, page 228.

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ATTACHING SIDE-OUTLET CARBURETERS*

C. W. STIGER:—The Carbureter Fittings Division has given the question of the method of attaching horizontal or side-outlet carbureters considerable thought and discussed the matter with a great many interests, with the result that it is prepared to recommend the retention of the present standard flange dimensions and the placing of the long diameter of the flange in a *vertical* plane.

CHAIRMAN WALL:—There is a good deal that can be said on this subject, although it is mostly up to the carbureter manufacturer. There is at present certainly a great demand for a standard method of attaching side-outlet carbureters. Nothing is stated in the report in regard to the dimension from the face of the flange to the center of the carbureter.

C. W. STIGER:—It would be very difficult to specify that, for the reason that various manufacturers by necessity have to vary that distance.

CHAIRMAN WALL:—The dimensions would naturally vary with different sizes and makes of carbureters?

C. W. STIGER:—Yes.

C. E. DAVIS:—It might mean a great deal to a manufacturer whether he could buy a different make of carbureter and adapt it to his car without a number of changes in its connections. If there is any way in which the carbureter makers can establish a standard which would be practical for the different makes, it would be well to get that dimension settled. It does not seem an insurmountable point to cover.

C. W. STIGER:—It would probably be as difficult to standardize that feature of a horizontal carbureter as it is to standardize the height of a vertical carbureter, which it has never been possible to do. From the very nature of their construction you will readily see that this would be quite impossible, by reason of the different principles of the various carbureters manufactured.

CHAIRMAN WALL:—A good many of the automobile manufacturers are fighting for a very slight difference in width under the hood, because of the streamline effect. It seems that it would be important to standardize the stated dimension if this could be done without too much of a revolution.

C. E. DAVIS:—When a manufacturer has a line of carbureters or connections, he does not desire to make a change to meet the conditions of the car manufacturer. On the other hand, his market is with the car manufacturer. If there is a way in which the point could be settled it is entirely desirable that it should be settled, as it would mean a standard practice in all lines. With all due respect to Mr. Stiger, this does not appear insurmountable. In some types of carbureter, where the distance is very short, it would not have to be

*For report of Carbureter Fittings Division, see January, 1915, BULLETIN, page 245.

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increased, whereas in the case of those wherewith the distance is great, it might have to be decreased. But there may be a middle ground for each type where the desired condition can be reached.

J. E. SCHIPPER:—I would like to to know if there is any real good reason for having the bolts in the vertical plane. It seems to me that if the bolts are in the horizontal plane there is greater accessibility because the lower bolt is very often concealed behind the carbureter in the vertical method of bolting.

C. W. STIGER:—That was very thoroughly discussed. There are many reasons for the recommended method of vertical bolting, the first of which is that the weight is very much better distributed on the flange. It is practically necessary to have a horizontally operating throttle on all horizontal carbureters to get the best results. It can be readily seen that with a horizontal flange and boltings this would be quite impracticable.

J. G. UTZ:—At the Standards Committee meeting held in November this point as to the position of the flange was brought up. Both the vertical and horizontal methods were considered, each having its disadvantages; the vertical, inaccessibility, the horizontal, interference with the throttle-shaft. At that time a 45-degree flange, which would get away from both difficulties, was proposed as an alternative. The committee was to report on that at this time.

CHAIRMAN WALL:—It developed that the 45-degree construction would involve a rather complicated foundry process and it was therefore not followed up.

C. W. STIGER:—When this question of method of bolting was first brought up, there was considerable diversity of opinion among the carbureter manufacturers. Now practically every carbureter manufacturer concurs in the recommendation made in the report.

J. E. SCHIPPER:—It seems to me that the dimension from the vertical flange to the center line of the carbureter would be determined by the small amount of clearance for the bolt, by the hood and by the necessity for hand room. Even if a definite dimension were not given, a minimum and maximum would be a needed guide.

CHAIRMAN WALL:—That would help but if the dimension referred to is not specified the carbureter manufacturer will take care of the clearance. As soon as the dimension were specified, it would be up to the carbureter manufacturer to provide room, which he might not be able to do unless several other dimensions were given.

C. W. MCKINLEY:—I believe that it would be advisable to recommend only that the overall width of the carbureter be made as little as possible, to keep within the limitations, so as to give the carbureter men a much better chance to work out their design. You cannot limit the carbureter to a certain space, because carbureter design is so diversified that a lot of them would not fall within the specifications unless the latter were made very broad.

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CHAIRMAN WALL:—I think the carbureter manufacturers will, for their own preservation, keep the width as little as possible. If it is desired to have a dimension added, it can be recommended that the Carbureter Fittings Division look into the question further. In the meanwhile a motion to accept this report is in order, unless there is further suggestion.

C. E. DAVIS:—I move the acceptance of the report of the Division, with the suggestion that further consideration be given to the matter of establishing the dimension as suggested by the Chair at the beginning of the discussion.

(The motion was seconded, put to a vote and carried.)

B. B. BACHMAN:—Would it not be well to have the Division give some consideration to the development of a standard list of unions for use on flexible tubing? Several companies are now manufacturing a flexible type of tubing, which will, I believe, be used in commercial vehicles especially. I think there is no standard line of fittings for use with this flexible tubing.

SPEED AND MILEAGE RATINGS OF ELECTRIC VEHICLES*

A. J. SLADE:—Mr. Chairman, the Electric Vehicle Division has the following recommendations to offer the Standards Committee for adoption:

SPEED AND MILEAGE RATINGS

Electric vehicle speed ratings shall be based on continuous operation with one-half load over hard, smooth and level roads or pavements at the actual average battery voltage.

Electric vehicle mileage ratings shall be based on the rated five-hour discharge capacity of the battery and a continuous run with one-half load over hard, smooth, and level roads or pavements.

These recommendations were adopted at the Standards Committee's last meeting but were incorporated in this report so they could go before the Society tomorrow.

(Continues reading report to the end.)

F. A. WHITTEN:—Of course, we realize that it is not possible to make a vehicle take the exact battery discharge rate, but the supposition is that the battery will be proportioned nearly to the vehicle. The idea was to get some common standard because the batteries vary so in capacity.

R. McA. LLOYD:—But electric vehicles are almost all run six or seven hours with the batteries that are in them.

F. A. WHITTEN:—Not necessarily with continuous operation. It is very unusual for electric vehicles to run continuously six or seven hours without stops.

*For report of Electric Vehicle Division, see January, 1915, BULLETIN, page 230.

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R. McA. LLOYD:—But if you are going to test them on asphalt with their standard battery equipment, most of them are going to run six or seven hours.

A. J. SLADE:—This recommendation is not intended to describe a particular test which will be made of a vehicle; it is a means of defining what the mileage capacity of the vehicle is. The rating can be made on certain predetermined assumptions.

F. A. WHITTEN:—While the mileage will vary a great deal with the rate at which the battery discharges, this is a matter for the manufacturer to settle when he makes his machine. He has to have a certain factor of safety. One may figure on a greater factor of safety than another, so the individual manufacturer has the right to make his rating anything he pleases, knowing what the efficiency of his particular vehicle may be.

CHAIRMAN WALL:—I think, as Mr. Slade says, that while the recommended specification may not constitute an exact test of any kind, as a comparison it is as good as naming any other length of time. All that is wanted is a standard of comparison. For instance, if a battery were capable of running seven or eight hours, the vehicle speed would be greater at the end of five hours than would be the case if the battery were capable of running only five hours. If all were tested on the same basis, would it not be possible to get very good comparative results?

F. A. WHITTEN:—It seems to me that would show in the manufacturer's guarantee of mileage. In other words, if a man has a machine which will run a great deal further on a certain power consumption, he *can* guarantee more mileage and *will* guarantee more mileage, and will have just as good a safety factor of reserve as the other man who has a machine that is not as efficient.

A. J. SLADE:—Each manufacturer will guarantee whatever total mileage he chooses. But when a comparison is made it seems necessary to have some discharge rate in order that we may define what these mileage ratings mean and make them comparable between different trucks.

E. R. WHITNEY:—The point that it is attempted to cover is—What is the battery rating? For instance, it is well known that with some batteries, if given a long overcharge, you might get as much as 25 per cent. greater capacity than if charged in the normal way, or 25 per cent. greater than the catalogue rating. Now, the question is, how is the mileage to be rated: on the rated capacity of the battery, or are you going to squeeze all you can get out of it and utilize the extra 25 per cent.? If one manufacturer bases his mileage on normal capacity and the other on the extra 25 per cent., we have no common basis for rating. It is, therefore, necessary to specify a definite basis of rating the battery for capacity.

A. J. SLADE:—This definition does not in any way prevent the

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manufacturer or designer from providing for any total mileage he may see fit.

R. McA. LLOYD:—Yes, but what is the object of the rating?

A. J. SLADE:—To give a basis for comparison. As a matter of fact, consideration has been given to this subject by all the members of the Division, which is composed of the executives, chief engineers or designers of all the manufacturers of electric vehicles, both commercial and pleasure, that are represented in the Society, and also representatives of the battery companies, and motor manufacturers. They all took part in the discussion, extending over a period of several hours, previous to our last Standards Committee meeting, and this was the net result of the deliberations. It was the consensus of opinion that this method of rating mileage gave a fairer basis of comparison than anything else that was proposed.

R. McA. LLOYD:—Did they all agree to the forty-two cell equipment for the lead battery? This is not going to be the practice of some manufacturers.

J. G. PERRIN:—Would not the standards vary according to the weight of the vehicles? Some of the lighter vehicles would certainly have different motor voltages and number of cells than the heavier ones.

A. J. SLADE:—There are really two standards at present. One of the leading manufacturers builds a line of motors rated at 80 volts for use with lead batteries. Another manufacturer makes practically the same motor, as far as its construction, capacity and so forth are concerned, and rates it at 85 volts. Now the engineers of both of those manufacturers, who are members of our Division, can compromise on the dual motor voltage ratings recommended in order that several motors made by different manufacturers but of practically the same characteristics, will have their characteristic curves laid out so that the manufacturer of electric vehicles can take either one and determine the motor characteristics without making tests and researches of each individual motor. Dual voltage rating does not affect the size of the motor; the capacity of the motor would vary, of course, in building a line of vehicles from small to large, but not the voltage.

J. G. PERRIN:—What I referred to more was, would you have the same standard for a thousand-pound delivery wagon as for a five-ton truck?

A. J. SLADE:—Yes, the same voltage. That is the practice now. A thousand-pound delivery wagon, with a small battery, would be equipped with an 85-volt motor, if the General Electric Company built it; and an 80-volt motor if the Westinghouse Company built it; and something else if the Crocker Wheeler Company built it. A five-ton truck would have a larger battery and motor but the voltage rating would not be affected. This is merely in the direction of the

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manufacturers of motors furnishing information which the electric vehicle manufacturer can utilize more advantageously than under the present method, in which there is no uniformity.

R. McA. LLOYD:—I want to point out what this really means as to rating. There would be a sort of S. A. E. rating for the mileage of a wagon. As an illustration a truck with a 200-ampere-hour battery, discharging at 40 amperes for 5 hours, might be credited with an S. A. E. rating of 40 miles, whereas it might actually go 60 miles.

A. J. SLADE:—Yes, just exactly as when we say a certain sized gasoline engine has 40 horsepower, A. L. A. M. or N. A. C. C. rating. On the block one will give considerably more, or another considerably less.

R. McA. LLOYD:—The only question in my mind is whether it might not work disadvantageously to somebody who is required by the Government or some other purchaser to furnish a certain mileage. That is all the rating he would get credit for.

A. J. SLADE:—No, not at all. That depends on the skill of the designer. In fact, it would work to the advantage of the manufacturer. He could get greater than the S. A. E. mileage with the same equipment. That would be a tribute to his ability.

R. McA. LLOYD:—He could not help getting greater mileage out of a well built wagon, as it does not take the five-hour rating of the battery. That is the principal objection I have.

A. J. SLADE:—I know of instances in which the current was taken at about a three-hour rate.

F. A. WHITTEN:—As a matter of fact almost any manufacturer's rating would be considerably more in practice. They all have a considerable margin of safety.

CHAIRMAN WALL:—Well, gentlemen, what are you going to do with this report? Do you wish to accept it or to change it?

E. S. FOLJAMBE:—I move that the report be accepted as submitted.

(The motion was seconded by Mr. McKinley, put to a vote and carried.)

YOKE AND ROD END PINS*

J. G. UTZ:—The last time we presented a report on the subject of yoke and rod end pins it was considered that we had not gone finely enough into details and so we have made a new table. I call attention particularly to the distance between the face of the standard S. A. E.

*For report of Miscellaneous Division, see January, 1915, BULLETIN, page 234.

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yoke and the edge of the cotter-pin hole. There was some question whether this clearance was sufficient. It was also requested that the dimension from the underside of the head of the pin to the edge of the hole, appear on the table for drafting-room convenience. The clearances as worked out show a minimum of .0081″ and a maximum of .0095″, which in the opinion of the committee is ample. In fact, we have examined some yoke and rod ends being manufactured and delivered to customers at present, in which the clearances are not as much as we specify on this table, and yet they seem to be commercially possible. The difference in diameter between the cotter-pin hole and the cotter pin is indicated. This, you will note, is considerable. Adding that clearance to the clearance first above mentioned, we have a total clearance of from .021″ to .023″. For the ½″ pin we stepped up to ⅛″ diameter cotter pin. The point was brought up that 3/32″ was used for ½″ bolts in the S. A. E. standard bolt list. That cotter pin of 3/32″ bears a relation to the root diameter of the thread on a half-inch bolt. But in this case the diameter is a full half-inch. Upon comparing the samples to these dimensions the 3/32″ cotter pin on the ½″ size looked altogether too small. Working it out in this manner we believe the ⅛″ cotter pin is correct. That calls for a 28 drill instead of a 36.

CHAIRMAN WALL:—This matter certainly seems to be excellently worked out. There is no question that the point of allowing plenty of clearance is a very important one, as it has a bearing on expeditious, economical manufacture.

C. E. DAVIS:—I move the adoption of this portion of the report as presented.

(The motion was seconded, put to a vote and carried.)

PITCH OF THREAD ABOVE 1½″ DIAMETER*

J. G. UTZ:—The next topic of the report of the Miscellaneous Division is pitch of thread above 1½″ diameter. We recommend two series of pitches, which seems to be quite necessary. The recommendations refer merely to the pitch, having nothing to do with the bolts or nuts or limits or any of the other possibilities, merely the number of threads per inch. We propose, from an inch and a half up, to have coarse and fine threads.

The coarse threads to be as follows: Beginning at 1⅝″ and advancing by ⅛″ increments and extending to 2⅞″ inclusive, 12 threads per inch.

I call attention here that twelve threads per inch is the S. A. E. standard pitch for 1½″ diameter bolts or screws.

Beginning with 3″ and advancing by ⅛″ increments to 5⅞″ inclusive, 10 threads per inch.

* For report of Miscellaneous Division see January, 1915, BULLETIN, page 234.

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Beginning with 6" and advancing by ⅛" increments up, 8 threads per inch.

The data we collected show that only one or two manufacturers use threads above 6" diameter and they were within 8". As to the binding effect of the threads up to 8" diameter, considering the railroad standard and several other standards, it seems that eight threads is satisfactory. There was a question whether the pitch should be six, but we believe that where dimensions above eight inches are used in motor car work it is not necessary to hold anything very tightly. They are used on spanner rings, hub caps and such devices, where not very much pressure is exerted.

In the fine thread standard, as submitted at the November meeting, we have made a little change. We had proposed to use eighteen threads per inch from 1½" to 3". The discussion brought out at that time and subsequent consideration in committee meetings has led us to recommend 16 threads right straight through. The slight difference between 16 and 18 seems to make it unnecessary to have two sizes. One is much easier to remember and work to. Therefore we have changed our recommendation to read "The fine threads to be as follows: Beginning with 1⅝" and advancing by ⅛" increments up, 16 threads per inch."

The form of thread is to be U. S. Standard.

It was suggested that in all cases above 3" diameters we advance by ¼" increments. We believe that that matter will work itself out with the tap makers; that while the ⅛" increment may be the S. A. E. standard, they may not carry the large dimensions in stock, because dies of that size are quite expensive. They will probably be made only on order.

The committee believes this recommendation is ready to submit to the Society in its simplified form.

C. E. DAVIS:—I move the adoption of this portion of the report.

(The motion was seconded, put to a vote and carried.)

FLAT FAN-BELT WIDTHS*

J. G. UTZ:—The next subject of the Miscellaneous Division report is flat fan-belt widths. This seems like a very simple proposition. Judging from the sizes of fan belt presented to the market by makers of woven cloth belts, I believe these makers are quite uncertain what widths they should make. Widths from ⅝" up to 1½" are found. It seems to be the best engineering practice to have the upper limit of 1¼" and the lower limit ¾", with one size between. Belts less than ¾" wide give trouble by twisting, if they get a little loose; and it seems that an 1¼" belt ought to swing as large a fan as anybody would care to use.

*For report of Miscellaneous Division, see January, 1915, BULLETIN, page 234.

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E. S. FOLJAMBE:—What about the man who drives electric instruments by the fan belt? I have seen fan belts two inches wide.

J. G. UTZ:—That is special, not standard practice.

A MEMBER:—I would like to ask whether the committee decided anything in regard to the thickness of the belt?

J. G. UTZ:—The matter of thickness was discussed. It was felt that the thickness of the belt had very little to do with the design of fan pulleys, either on the fan or on the motor, and that thickness would be more or less optional, being partly dependent on the diameter of pulleys used. When very small pulleys are used not quite so thick a belt is wanted. We might carry the matter a little too far and make it too complicated by trying to specify anything except the width. The leather belt can be used thicker than some of the woven belts, and we might be working an injustice to some by laying down a standard of thickness, which makes very little difference in design.

J. G. PERRIN:—I would like to recommend that the figures named be specified as maximum. There are no tolerances allowed at all. I also recommend that the minimum distance between the flanges on the pulleys be specified, because if there is not the right clearance there the belt will ride on the flanges. If there is a maximum in fan belt width, and a minimum distance between the flanges on the pulley, they will insure the proper fit of the belt.

J. G. UTZ:—We ran right into that the first thing. It was our impression that that would be rather laying down rules for the engineer to be guided by. Most designers and engineers have different opinions on such things as that. If we standardize the width of the belt, the question of limits comes up, and we were rather glad to receive a discussion on that. But as to the amount of clearance in the pulley, if the designers have the fan belt width, they can work that out to suit themselves.

J. G. PERRIN:—Yes, if the fan belt itself is made the maximum. That automatically covers that point, I believe.

J. G. UTZ:—The viewpoint was that the standard would be useful in this manner: the designer would proceed until he reached the point of the width of the fan belt; his data book would show him what widths are standard, obtainable on the open market, and he would have something to guide his future design; merely giving a point of relation between the fan-belt maker and the fan and motor maker, being a sort of connecting link between parts of the work.

F. A. WHITTEN:—I rather agree with Mr. Perrin that there would be some differences as to what that inch and a quarter means. It should be stated as the maximum, because I believe the belt manufacturers do not know what a sixteenth of an inch is. You get 1¼″ belts that are 1 5/16″ and 1 3/16″.

E. H. EHRMAN:—It is possible we might get into trouble with

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respect to such a specification because a leather belt in the making is stretched and if it is exactly to the nominal width, it may, after it has been in the roll or coil for some time shrink in length and increase in width and thickness, so that it would then be a trifle more than the nominal width. This would amount to much less than 1/16" in the width under consideration. At the same time, I think it would be unwise at this time to place any limits on belt widths.

CHAIRMAN WALL:—It seems that we should have a maximum limit whether we have a minimum or not.

J. G. PERRIN:—I think that if it is merely recorded that the figures are maximum, a slight reduction in width would not cut much figure. But the belts should be no wider. For instance, a man makes his pulleys and gives 1/16 or 1/32 clearance, and the belts come a little wider than he figured on, then he runs into trouble. Whereas if his inspection department makes sure that the belts are no wider than specified, the necessary clearance would be taken care of automatically, because a ⅛" lessening of width will not do as much harm as a 1/64" increase might, depending on the clearance. I have seen woven belts which varied considerably in width, and the edges seemed to fray out a good deal. Of course with leather belts the edges are different. I move that the word "maximum" be added to the figures of width specified.

(The motion was seconded, put to a vote and carried.)

CHAIRMAN WALL:—Is there any further discussion on these fan belts?

E. H. EHRMAN:—I move that the report be accepted.

(The motion was seconded, put to a vote and carried.)

HOSE CLAMPS

J. G. UTZ:—The matter of hose clamps, assigned to the Miscellaneous Division, we gave some consideration, immediately encountering the fact that before we can step from the pipe to the clamp we must have the hose. We will collect some data as to hose connections which we may submit in connection with hose clamps recommendations, giving a table of dimensions. The diameters and plies of water-pump hose are quite variable. We may be able to specify or standardize inside and outside diameters of hose and a series of lengths for each combination of diameters, giving the hose manufacturer a chance to prepare some sort of a stock.

COTTER PINS

The matter of cotter pins is a complicated one, in spite of the fact that it looks simple. The report will have to be a tabulation something in the nature of the steel tubing data sheet, which at one time was reduced from over 1500 sizes down to 160.

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ROLLER BEARING SIZES*

J. J. JENNINGS:—The report of the Ball and Roller Bearings Division is merely one of progress. The committee has prepared a table of suggested stock sizes of taper roller bearings. This is only very temporary. It will be sent for criticism to people who are users of this type of bearing. When these opinions are given they will probably be tabulated and at the next meeting there will be something definite to propose.

Some steps have also been taken to standardize the complete thrust bearing, but no report on the subject is ready.

C. W. MCKINLEY:—I move we accept the report of the committee as a report of progress.

(The motion was seconded, put to a vote and carried.†)

SPRINGS DIVISION REPORT‡

CHAIRMAN WALL:—The Springs Division report covers the ground of a remarkably broad subject very thoroughly. One thing in the report might have been expressed more clearly. It reads "The test to be made by inserting two 3′ bars in the eyes, the ends not to be more than ⅜″ out of true with each other or with the main leaf."

It appears that the word "parallel" should be inserted.

C. W. MCKINLEY:—We had considerable discussion in regard to that paragraph in committee; in fact, we argued it pro and con for about an hour and finally thought we had it worded so it would be perfectly clear, because we say that the eyes of the main leaves must be parallel and square to the main leaf and parallel to each other, and then specify that the tests are to be made by inserting the two 3′ bars, the ends not to be more than three-eighths out of true with each other. For instance, if you had the spring on a flat plate and one end of the test bar should rise vertically, say the left of the spring, and the other rise vertically to the right of the spring on one end, they might be parallel in one plane but would not be parallel with each other in all planes. If you measured directly between the two it would give you more than three-eighths inch out of true, because measuring from the one end to the other, if it was three-eighths inch out of true in this way in the horizontal plane, taking a diagonal length it would always give you a little more, always be one sixty-fourth or one thirty-second more; so we considered that the definition would hold true in any case.

CHAIRMAN WALL:—It has been remarked that it should be specified how far through the eyes the bars should be put; in other words,

* For report of Ball and Roller Bearings Division, see January, 1915, BULLETIN, page 233.

† The Ball and Roller Bearings Division report was presented at the Annual Meeting of the Society as a progress report only.

‡ For report of the Springs Division, see January, 1915, BULLETIN, page 237.

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if they were put only half way through, that would make fifty per cent. difference.

W. M. NEWKIRK:—That would make no difference; if you have three feet sticking out one side, you would get the same result.

C. W. MCKINLEY:—As long as both bars are inserted the same distance.

CHAIRMAN WALL:—That means a ⅜" difference in the distance between the ends?

C. W. MCKINLEY:—Yes. In the test itself it is almost impossible to make a mistake. It appears probably a little confusing in the language, but we have not found any trouble in applying it.

CHAIRMAN WALL:—In regard to the name "one-quarter-elliptic cantilever," I understand the committee have threshed this over pretty carefully, but it looks to me as if this is a quarter elliptic spring. I was just reading the definition of a cantilever in the dictionary, though I realize that in these things we are the ones who determine the nomenclature. According to the dictionary a cantilever is a "long, bracket-like truss, supported upon a pier and balanced or counterweighted." Would you say that this quarter elliptic cantilever, as it is called, is balanced or counterweighted? That we know is the requisite of a true cantilever. I would very much like to have any of the committee tell us wherein the "one-quarter-elliptic cantilever" differs from a quarter elliptic spring.

W. L. BLISS:—As a strictly technical definition of a cantilever, it seems to me it might be well to bear in mind the definition adopted by bridge engineers, namely, that a cantilever as distinguished from a truss, is a beam in which the maximum bending moment and the maximum shear occur at the same section, whereas in a truss the maximum moment and the maximum shear do not occur at the same section.

In the case of Fig. 1, there could be no question that the maximum bending moment and the maximum shear both occur at the first fastening nearest the outer end of the spring. The maximum shear and maximum bending moment in Fig. 2 may occur at both points of fastening as this is a type of balanced cantilever. In the case of Fig. 3, the maximum shear and the maximum bending moment occur at the same point that they do in Fig. 1. In the case of a half elliptic spring, however, the maximum shear and the maximum bending moment would not occur at the same point, as such a construction is a truss. Therefore, the definition of cantilever adopted by bridge engineers would apply to springs as well as it would to other forms of construction. No matter how rigid a structure may be, it is subject to deflection under load and unless loaded beyond the elastic limit complete recovery will take place after removing the load. A spring like those under discussion is simply a beam so constructed as to admit of great deflec-

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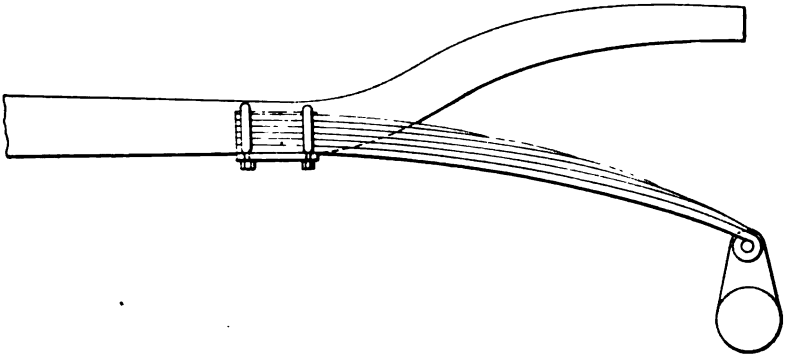

FIG. 1. One-quarter-elliptic Cantilever.

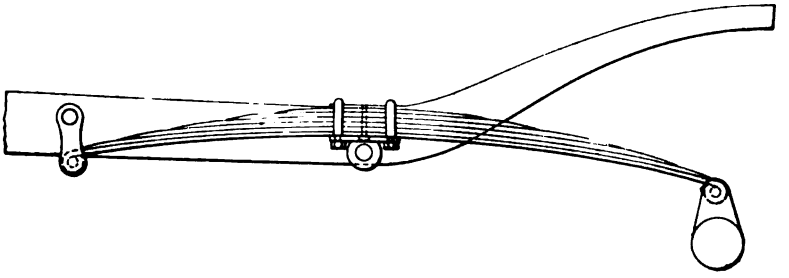

Fig. 2. Half-elliptic Cantilever.

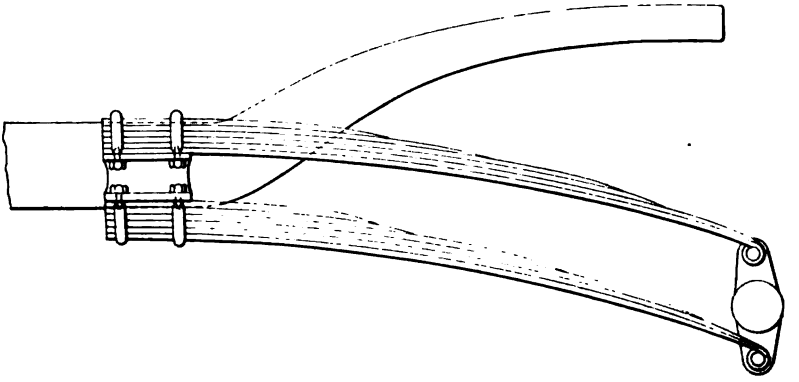

Fig. 3. Double-one-quarter-elliptic Cantilever.

tion without rupture, and as a spring is stiffened it approaches in characteristics those of a rigid truss or cantilever, as the case may be.

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CHAIRMAN WALL:—I think the point is very well taken in regard to the stress and the bending moment. But what I do not quite see is wherein a quarter elliptic is different or how otherwise you would attach a quarter elliptic.

W. L. BLISS:—I quite agree that Fig. 1 represents either a cantilever spring or a quarter elliptic. It is purely a question of nomenclature.

W. M. NEWKIRK:—I think that a distinction must be drawn between a spring such as Fig. 1, which is a complete unit, and a somewhat similar spring, such as the upper member of a three-quarter elliptic spring. The latter in itself is undoubtedly a cantilever, but it should not be given that name because it is not the entire spring, and the spring as a whole has its own well-established name.

C. W. MCKINLEY:—The cantilever in this case, according to the opinion of most of the members of the committee, does not refer to the form of the spring, but the form of suspension. The spring itself is determined by the qualifying name "quarter elliptic," and the method in which the spring is used is determined by "cantilever." It is a different method of suspension than used with the ordinary half elliptic, three-quarter elliptic or platform, and to designate that type where the spring itself is carried on the chassis and supported at one point only, the shackle point at the axle, we desired to employ the word "cantilever" in conformity with general usage. Strictly speaking none of these three types is on absolute cantilever. If one wanted to hold to the dictionary definition, "cantilever" would not apply to them exactly.

J. G. UTZ:—The term "cantilever" is applied to a beam which has practically no deflection, or at least very small deflection. The term cantilever is entirely foreign to a spring, where the deflection is considerable.

It is further of interest to note in respect to the matter of maximum stress and maximum shear which Mr. Bliss brought up, as to the quarter-elliptic cantilever, as described in the report, that most springmakers endeavor to produce uniform stress throughout the entire length of the spring.

It is further to be noted that what is called the quarter-elliptic cantilever is being used on a number of cars, and being referred to as a cantilever spring without any further indication as to what portion of the ellipse it is.

It seems to me that the matter is so confused that the Nomenclature Division should decide upon it.

W. M. NEWKIRK:—I move the adoption of the report.

(The motion was seconded, put to a vote and carried.*)

*The report of the Springs Division was not considered for adoption at the Annual Meeting of the Society, owing to insufficient attendance at the time it was presented.

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NOMENCLATURE OF CAR PARTS*

G. L. MOSKOVICS:—It is pretty generally agreed that the chief value of standard nomenclature is for the man in the street. That is, the engineer understands the various terms which are used to designate any part, but some confusion exists on the part of the owner as to what is meant by "piston pin" in one case, or "wrist-pin" or "gudgeon pin," and so on. We are working with a view to standardizing the nomenclature used in parts catalogues, which of course will serve in the drafting-room as well.

CHAIRMAN WALL:—Those who are not intimately acquainted with a proposition of this kind and have not gone into it very deeply hardly realize how much work it requires. You can see that there is a great amount of work ahead of this committee. It is a subject on which we have had considerable difficulty in getting very far advanced. It appears that the office has now not only made considerable headway, but mapped out an excellent system. A discussion on the subject in detail would probably last several years, but there may be some points that are worth bringing out which the committee would like to have brought out.

J. E. SCHIPPER:—Under the general division II, subdivision A, the transmission is mentioned. I think there has been a tendency towards calling that part of the transmission which comprises the transmission gears, the gearset, which I think is a logical thing to do, because the transmission itself refers to the gearset as well as the shaft, the universal joints, the rear axle and anything that takes the drive from the motor to the rear axle or the rear wheels. I think it would be a wise move to adopt that policy and call that part of the transmission the gearset. Then it would be the gearset, gearset case and all the other subdivisions that logically come under that head.

G. L. MOSKOVICS:—This list does not attempt to go at all into nomenclature *per se*, the idea being, for example, that the subdivision "transmission" will be taken under consideration by the manufacturers of transmissions and their recommendations as to the actual names to be used taken under advisement. While we tried to select the names as nearly as we could according to standard practice, yet they are not set forth as recommendations for nomenclature; they are simply indications of how far any one group of parts will extend in determining upon the nomenclature in general.

N. B. POPE:—We have already adopted the practice of having the Standards Committee Divisions introduce the subject of nomenclature in their reports. It seems to me that that idea is a good one. Far be it from me to suggest that we saddle the Divisions with the task of thoroughly naming all the parts involved in their subjects, but I do think it would be well, after information such as has been described here is obtained, to submit it to the various Divisions for their infor-

*For report on Nomenclature, see January, 1915, BULLETIN, page 248.

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mation and criticism; because they are composed of men who are expert in the various lines and their points of view would be good and their criticism worth while. It ought to do them good to have their attention called to the importance of nomenclature.

CHAIRMAN WALL:—That sounds like a good suggestion, provided it would not take too much time. It takes a great deal of time to get any of these things through a Division.

N. B. POPE:—My idea, Mr. Chairman, was that lists should be made up by the manufacturers of the respective parts and submitted to the divisions for criticism only.

CHAIRMAN WALL:—I think that probably the present committee would approve of that. At present the main object is to get the names introduced. Criticism will, of course, come afterwards.

K. W. ZIMMERSCHIED:—Everyone has a different idea as to how parts of a car should be grouped together, and as to what should be the ruling principle in naming these groups and parts. I think we will never get very far in this work of nomenclature until we decide upon a fundamental program, and then fill in the details, agreeing to take the result as, in the main, final; because, the moment we begin to argue about the details of the names themselves, our chance of success is lost.

This problem is to an exceptional degree an arbitrary one, and it is only by giving our common consent to abide by the results of careful and deliberate arbitration that we can hope to progress in it.

B. B. BACHMAN:—Do I understand correctly that the tendency on the part of the Nomenclature Committee at the present time is to extend their energies towards the recommending of a standard system of numbering for parts catalogues?

G. L. MOSKOVICS:—That is incidental to nomenclature.

B. B. BACHMAN:—I think they have a pretty big job if they are going to take all the names they have to draw on and arrange numbers for the spare parts catalogue; they have my utmost sympathy. I have had the pleasure—I think you might call it the punishment—of fixing up two parts catalogues during the last five years for our own organization, and everybody who has had a hand in that job has gotten thoroughly cursed by everybody that did not have a hand in it; and I can say if you try to arrange that for the whole industry you have got a job on your hands that you will wish you had left alone.

CHAIRMAN WALL:—I know of no subject on which there is such a wide variation of opinion as on this. As Mr. Zimmerschied said a few minutes ago, we will have to adopt some one's idea and let him go ahead and work it out, or we will get nowhere at all. As far as numbering the parts is concerned, I think that is very much a secondary matter, and that the getting of names is certainly more important. If we ever succeed in getting standard names for parts, the numbering would come in very easily.

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R. McA. LLOYD:—I believe the method that has been adopted is quite proper and advantageous, and I have no doubt the committee are very willing to receive suggestions from any Divisions of the Standards Committee or any one else who would help them. Eventually I suppose this matter will be combed over a good deal by all the groups in the Society before we actually publish what we think can be adopted. This report is merely for suggestion and discussion at this time. But let us say that something is being done.

CHAIRMAN WALL:—That seems to be the idea.

(On motion, duly seconded, the report was ordered accepted.*)

PNEUMATIC TIRE STOCK SIZES†

CHAIRMAN WALL:—There is no doubt that the report of the Pleasure Car Wheels Division will cause a great advance and be a great help to both the manufacturers of tires and the automobile manufacturers. Is there discussion on it? We would like to bring out any points.

F. F. PHILLIPS:—I move its adoption as read.

C. C. CARLTON:—Mr. Chairman, before this report is adopted it might be well to call the attention of the members to the fact that it contains quite a radical recommendation. It says, "Even tire sizes are for manufacturers and consumers. Odd or over size tires are for consumers only." That is very different from the present practice of tire manufacturers. In the list of sizes for consumers only you will recognize many tire sizes which are being used as initial equipment by the car manufacturers at the present time.

CHAIRMAN WALL:—How are we going to get car manufacturers to not use those sizes which are for consumers only?

E. R. HALL:—The point was made at one of our meetings that one of the large car manufacturers was equipping his cars with 32 x 3½ rims and 33 x 4 oversize tires, as initial equipment. I think that in a number of cases it has been shown that a car manufacturer could use a 32 x 4 rim and a 32 x 4 tire (which would give him the tire diameter he originally desired when he designed his car for a 32 x 3½ tire), and could purchase this even size equipment at the same or a little lower price than he would have to pay for the larger size 33 x 4 tire, even though the 32 x 3½ rim costs a little less than the 32 x 4.

We think the car manufacturers will appreciate the fact that if they put on even size tires, as initial equipment, they will give much

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*The report was submitted and approved as one of progress at the 1915 annual meeting of the Society.

†For report of Pleasure Car Wheels Division, see January, 1915, BULLETIN, page 247.

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more satisfaction to their consumers, because the consumer will have an opportunity to put an oversize tire on his original rim equipment.

HENRY M. LELAND:—I am not familiar enough with this report to talk intelligently about it. I think that if it simplifies the matter or makes it more effective in any way, it ought to be ultimately adopted. I do not know but what it ought to take effect some time in the future, when the tire manufacturers and automobile manufacturers shall have studied it thoroughly and made sure that they are ready for the change. It is a very serious matter for manufacturers to have to put on a variety of sizes of tires, that is, a variety affecting the base diameters, involving a change of rim.

We are seriously handicapped by the fact that there is no standard, but chaos, in metric sizes. While our shipments abroad at the present time are comparatively limited, this is a considerable annoyance to us. While we are making but one size chassis, and so far as the American trade is concerned would like to use only one size wheel, yet we find today, when considering the various types of the different makes of tires we have to use we are carrying thirty-two types of tires. Insofar as the metric sizes are concerned, it means a different sized rim in many cases. That makes it necessary to have wheels in stock, all painted, to go with any given car, which is very expensive and a serious handicap at times.

In the early days we were confronted with a very serious problem along that line in this country. Our tire manufacturers had no standard. I think nearly every maker furnished a different base diameter, and also a different width; we had to have as many different sized wheels as there were makes of tires. I have seen the time when we were trying to ship forty cars a day and of two hundred cars which were all ready except for tires there would be perhaps only twenty shipped because we had not wheels and rims painted of proper color with which to equip them. It was a continual perplexity. We took the subject up at that time very earnestly with the tire manufacturers. They were quite reluctant to change, because it meant a great expense to them, but they were finally persuaded to standardize. Now as far as American tires are concerned we have very little trouble of this kind.

There is, however, a good deal of trouble due to variation in the outside diameter of American tires, that is on what we call the efficiency load diameters. When a car is loaded with five passengers, there is a difference in the diameter of the tire, in some cases as much as the difference between two sizes of tire of the same make. Some have a variation of, I think, 4.28 per cent. in the reading of the odometer, which is certainly very wrong, and decidedly unfair to a manufacturer who may have a car that is very economical of fuel.

We have had much trouble in that direction with the metric sizes; the variation we find in some cases is over 8 per cent.

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Those things might well have the attention of the Standards Committee. While there is a good deal of chaos across the water now in some directions it will all be cleared away some day. It would be well if we could be prepared to say to our friends across the water that we want them to standardize the same as we standardize in this country.

As far as changes in this report are concerned, I am not familiar enough with it to know just what they are, but I certainly hope we will not invite any objections to it or any criticisms by undertaking to force it before those interested are ready for it. I think the tire men and the automobile manufacturers ought to have an opportunity to adjust themselves to any changes that are to be made. But nobody can be any more heartily in sympathy with or feel the need more of standardization than I.

CHAIRMAN WALL:—The tire manufacturers are the ones who are getting up this standardization and suggesting these changes.

E. R. HALL:—Mr. Chairman, the sizes recommended in the report have been adopted as standard by the Clincher Automobile Tire Manufacturers' Association, made up of representative tire manufacturers and rim manufacturers throughout the country.

C. C. CARLTON:—Mr. Leland has submitted a very interesting lot of data on the subject of the percentage of error in speedometer readings due to varying outside tread diameters. This is one of the most difficult things to solve that can be imagined. We have a standard tire seat diameter for each size tire. To get the tire companies to come to a standard outside tread diameter is going to be very hard.

MILLIMETER RIMS

In his statement Mr. Leland lays stress on the chaotic condition of the millimeter tire sizes. I was just wondering what the Standards Committee could do to make more effective the action recommended to it today. If I might be permitted briefly to review recent history of millimeter rims it might be worth while. Every pneumatic rim made in Europe was made to a different diameter and different profile. You sent a tire over to Europe to run on a Michelin rim and it had one kind of fit for a Michelin rim, and if it was used on a Dunlop rim or a Continental, it had another kind of fit. The fact is that American standard millimeter tires were miserable fits on any European rim. The result was a lot of trouble. The American companies conferred and made an American standard for millimeter tires and profiles. Then the Society of Motor Manufacturers and Traders made its standards. The American tire manufacturers then adopted the entire list put out by the Society of Motor Manufacturers and Traders of Great Britain. It would seem that we accom-

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plished something when we did that, but we have not gone very far yet.

I believe I am correct in saying that today every millimeter tire made by any of the larger American companies is made to the standard circumference and profile adopted in Great Britain. But over there they do not seem to have followed the standard that was adopted there. The curious part of it is that they have made their inspection tolerances so liberal that the maximum tolerance of one size will overlap the minimum tolerance of the next larger size. It is a real problem. If this Society can do something to get the Europeans more deeply interested it would certainly be the biggest thing it could do for the tire business and all the car manufacturers who are exporting cars.

SOLID TIRES

It does not come within the province of the Pleasure Car Wheels Division, but I would like to bring out, with your permission at this time, Mr. Chairman, the fact that every American tire manufacturer is now being called upon to make certain metric sizes of solid tires. A manufacturer in America starting out today to make solid tires on metric diameters is absolutely at a loss. There is in Europe no such a thing as the standard S. A. E. band we have in America. I find that the British Engineering Standards Committee in co-operation with the Society of Motor Manufacturers and Traders of Great Britain had, previous to the outbreak of war over there, drawn up what they called an "interim report," in which standard band diameters were specified.

C. B. WHITTELSEY:—I have seen reports published to the effect that the American manufacturers were very severely criticized for sending trucks over there equipped with tires that were different from the European standard, intimating that there was a standard, and threatening to refuse to accept any more trucks not equipped with tires in accordance with European standards. It seems to me that inasmuch as we have a well established standard the logical thing to do is to try to get them to adopt our standard.

SECRETARY CLARKSON:—Mr. Chairman, we have been in communication for some time with the Engineering Standards Committee of England, which is supported by the various scientific societies there and also works in co-operation with the Society of Motor Manufacturers and Traders. They have copies of all of our publications, data sheets and reports. When the matter under discussion first came up we furnished the British committee again with copies of our motor truck wheel standards. Last October this committee made the interim report referred to on rim standards for solid tires. They sent us copies of the same. We also had advices that the standardization was not advancing with satisfactory rapidity. That is about all we have been able to learn on the subject. It appears, however, that there is not abroad the willingness to which we are accustomed to scrap molds

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and equipment for the common good. It is said that the rim standards tentatively recommended in England include a large percentage of the sizes which have been used there in the past. It is clear that if the proposed European standards are adopted, there will be no interchangeability with American standards. In the interim report mentioned it is stated that some features of the standard, aside from the rim diameters, remain to be decided upon. We have asked for prompt further information and pointed out the desirability of the Europeans conforming to our standards so far as possible. Some of our members have gone abroad especially to interview them on the subject.

CHAIRMAN WALL:—The Commercial Car Wheels Division should take this matter up and see if anything can be done. It looks like almost a hopeless task, but the Society has repeatedly standardized matters which appeared equally hopeless here.

Is there any further discussion of this matter?

(The motion to adopt the report of the Pleasure Car Wheels Division was seconded, put to a vote and carried.)

TOOTH FORM OF SILENT CHAINS

CHAIRMAN WALL:—Mr. F. D. Howe, a member of the Society, has suggested that a standard tooth form for silent chains be adopted. The importance of this is realized where the car manufacturer is using more than one make of chain. As it is now, it is absolutely necessary for him to have differently cut sprockets for each make, to get proper results. It would be of great advantage in several different ways if the chain manufacturers would adopt some standard. We would like very much to hear from the chain manufacturers in regard to this matter.

FRANK L. MORSE:—Mr. Chairman, I think that the matter of standardization of tooth forms, that is, as to the interchangeability of the sprocket wheels, has not been considered by the chain makers. A year ago I sent out a call to the various chain makers asking them to standardize the pitch. We have not gone any further than that. The pitch of the chain used by different makers in the United States varied something like .01″, and as it was essential that the center distance on the engine should be the same for all chains if the chains were to be interchangeable by furnishing new sprockets, I thought it would be very desirable if we could standardize and agree on some limit of variation for the pitch. I suggested then that the pitch of a ½″ chain, for instance, be .500″ to .501″. On account of there being a considerable stock of chains already manufactured of a different pitch, it was decided that the standardization should be deferred until some later date. I think that now we all are making this size of chain of .500″, with some tolerance from this figure, but I do not know just what has been decided by others. Our guarantee, as far as the chain we are putting out now is concerned, is .500″ to .5007″ per pitch; that is,

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a tolerance of .0007" per pitch. If other makers have found out the angle of link which they feel is desirable they have gotten further than we have. I am frank to say that we do not know what the angle of the link should be, nor are we sure as to the outside diameters of the wheels.

CHAIRMAN:—Gentlemen, we would like to get as much light on this subject as we can.

JOHN R. CAUTLEY:—I am in very much the same position as Mr. Morse. Of course, in the first place, for the automobile business we have only to standardize the half-inch and the smaller pitches. The first difficulty comes in the question of what the smaller pitch should be. I believe Mr. Morse is using ⅜".

FRANK L. MORSE:—Yes.

JOHN R. CAUTLEY:—Then we can say that the American manufacturers and my own company are working on the ½" and ⅜", while one of the English companies is working on the 10 and 8 millimeter; which is the first problem. Another problem is the pitch limits which Mr. Morse has given, which is practically the pitch limit we use. I do not know about the other American concerns. I know that recently one of our competitors was using a pitch considerably away from standard.

Then there is the link angle. I believe all the chain makers use approximately the same; that is, we are supposed to average 60 degrees between link faces. Whether that is absolutely correct or not I cannot say. My own concern started with 52 degrees, went to 80 degrees for certain work and found it unsatisfactory and came back to 60.

Then in addition to that we have the question of standardizing the guiding links. The other concerns are using almost exclusively for the automobile work what is known as the outside guide. I think Mr. Morse is using the center guide.

Then we have to go on to the question of the perpendicular distance from the link face to the center of the pin or theoretical center..

Furthermore, there is the question of the width of the chain. Each manufacturer has his own ideas as to the thickness of the individual link. So when you make combinations, that introduces another difficulty.

For these reasons we have about six or seven variables to be taken into consideration. It is going to be a very difficult matter to get even an approximately standardized chain. Whether it can be done is very questionable in my mind. I took it up with Mr. Renold when he was over here two years ago; we talked it over very carefully and doubted if it could be done at present. Of course, there are only two pitches of chains to be considered, and I can say without writing to Mr. Renold, that if there is any possible way that we can help by modification of our own chains we would be only too glad to do so. As a matter of fact I am offering to send Mr. Morse very soon some

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samples of chains of a new variety which will not only run on our own wheels but on the wheels of our competitors, the Coventry Chain Company in England. Whether they will run on American wheels I do not know. I think they will run on Mr. Morse's wheels if he has 60° link angles.

That is as far as we have got, but we are perfectly willing to submit the layout of our sizes and turn them over to the other manufacturers, if they will be good enough to let us have the same information, so we can figure out what we can go to. The greatest stumbling block is Mr. Morse's center guide, on which he has a patent. So that we could not interchange with him if we wanted to. As a matter of fact we use the center guide on chains used anywhere save in the United States. But we also use outside guide chains or flanged wheels where they are to be preferred.

I think we would all be glad to go into the matter if feasible. The whole question of sound chain design, as Mr. Morse suggests, and he has been working on it as long as any of us, is in a very fluid state. I think it would be very difficult to standardize silent chains. However, I am perfectly willing to co-operate in trying to do so, if only to find out that it is impossible at present.

CHAIRMAN:—Is there any further discussion on this subject?

R. McA. LLOYD:—Is this matter to be referred to some existing committee or will a new committee be appointed?

CHAIRMAN:—If the Standards Committee decides that it wishes to have a Division appointed to consider the subject, the Council will probably appoint it.

FRANK L. MORSE:—We have found that the elasticity of the chain has a very material bearing on the amount of noise it will make in a car; and further than this, for different cars a change in elasticity may be desirable. For instance, if we put a chain having an elasticity per link under 100 pounds' tension, of .001", we find by changing that to an elasticity of .0006" per link we have a quiet-running chain, whereas before we had a very noisy chain. This variation in elasticity of the link is accomplished by changing the height of the arch. It seems to me, in view of experiments that we are conducting, that there should be no standardization at present of the link of the chain or the outside diameter of the sprocket wheels, but if there were standardization of the pitch, as has already been pointed out, any maker could substitute another chain by simply changing the sprocket wheel, and oftentimes that would not be required. I think that with all the makers except ourselves the chains will be interchangeable; and of course that comes in view of the design of the center guiding link. We think one guiding link is a little better than two; that is, use both sides of one link rather than one side each of two. I am not sure but what our company would be willing to permit others to use the center guiding feature if it is found desirable. We would not be willing to go to the outside guiding feature, as it is radically wrong.

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To standardize, I am not sure but the Morse Chain Company would be willing to open that field so that all could use the center guide. We would be very glad to get the cars and the sprocket wheels so standardized that any chain could be used. But again the shape of the link has, I think, to be changed for different cars, unless the harmonics of the engine can be changed, and that is a pretty big field.

CHAIRMAN WALL:—Mr. Morse, would it not be well to have a committee on this subject, to standardize what parts can be standardized at present, and work on towards further standardization in the future?

FRANK L. MORSE:—I think it would be very desirable indeed. That is especially true in reference to making the sprocket blanks, in some cases of forgings, and in other cases from bar steel. If we had an approximate size of forgings, so that wheels could be made for any maker of the different chains, that would be very desirable. The center distance is the most important, which would call for a standard pitch.

R. MCA. LLOYD:—Mr. Chairman, it is essential to have a majority or a large part of this Division, if it is created, composed of the chain manufacturers themselves. I think it is hardly worth while to refer the subject to one of the existing Divisions. I move that the Council be requested to appoint a committee on chains and sprockets to report at some future day.

(The motion was seconded, put to a vote and carried.)

COKER F. CLARKSON,
Secretary.

Note.—The reports as accepted of the Iron and Steel Division and of the Standards Exchange Division and the discussion of the same at the 1915 Annual Meetings of the Standards Committee and of the Society will be printed in a later issue of the BULLETIN.

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DISCUSSION OF STANDARDS COMMITTEE REPORTS AT THE ANNUAL MEETING OF THE SOCIETY

Held at the Engineering Societies' Building

The meeting was called to order with Vice-president Zimmerschied in the chair.

CARBURETER FITTINGS*

SECRETARY CLARKSON:—The report of the Carbureter Fittings Division relates to one new matter, one change in previous recommendations and one addition to the previous recommendations of the Division. The new subject is the one of flanges in connection with horizontal or side-outlet carbureters, the principal point with regard to the same being the method of bolting, whether the bolts should be in vertical or horizontal plane. This is a subject which has been discussed at length at two meetings of the Standards Committee and there is no difference of opinion in the Carbureter Fittings Division at present as to the recommendation which it makes at this time, which is as follows:

"We recommend the retention of the present standard flange dimensions, and the placing of the long diameter of the flange in a *vertical* plane, for carbureters of the side-outlet type."

The recommended modification of the present flared tube union fittings standard is to increase the tolerance now specified for the union nut bore (dimension *M*, S. A. E. Data Sheet 35a, vol I.) from 0.002" to 0.005" for all sizes.

The recommended extension of the present S. A. E. standard is to include flared tube union fittings in ⅝" and ¾" sizes.

CHARLES D. SHAIN:—Nothing is said in the report about threads in the flange of the side-outlet carbureter. As I understand it, the carbureter is to be direct-connected to the engine. It would seem that there should be studs in the cylinder block. In that case only plain holes are required in the carbureter flange. The standard S. A. E. specifications call for threaded holes.†

A MEMBER:—I move the report of the committee be adopted.

(The motion was seconded, was put to a vote and carried.)

FELLOE BAND THICKNESS

W. P. KENNEDY:—The report of the Commercial Car Wheels

*For report of Carburetter Fittings Division, see January, 1915, BULLETIN, page 245.

†The specification of threaded holes in the S. A. E. standard flange dimensions is for use only where threads are required and is not compulsory.

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Division is very brief, reduced to practically one resolution, which was printed in the BULLETIN for December (page 146), as follows:

"Resolved, that an increase in the felloe band thickness from ¼ inch to ⅜ for 4 inch single tires be recommended."

The reason for this is that a good many of the tire manufacturers, wheel manufacturers and vehicle manufacturers have been of the opinion that the ¼-inch band is not sufficiently rigid to support the wheel, or more particularly the tire; and it is therefore desirable to increase the thickness on that particular size.

We have in mind offering for acceptance at the next general meeting of the Standards Committee and presentation subsequently to the Society, another resolution which reads as follows:

"Resolved, that there be recommended for adoption at a later meeting an increase in felloe band thickness from ⅜ inch to ½ inch for 6-inch dual tires and over."

There appears to be a necessity for an increased thickness in the felloe band on wheels having dual 6-inch tires and over, due to the fact that on account of the design of the wheels for these sizes of tire, having off-set spokes, the strain in the use of motor trucks has a tendency to disrupt gradually or break down the felloe bands; and this thickness would be an aid in some measure in taking care of the present difficulty, although originally, of course, the felloe band was not intended to support the structure but merely hold the wheel in its integrity pending the application of the tire. But so long as we have to contend with wood wheels with offset spokes it appears desirable to do anything that may be possible towards increasing the greater rigidity of these wheels. The reason the recommendation for adoption is not made at this time is that there is a serious question whether the weight and price involved in this change are desirable, because of the present small margin that exists between the present cost of wood wheels and the cost of metal wheels; and also by announcing our intention to make this recommendation at a later date we provoke such discussion and comment, correspondence and so forth, as may enable us to determine upon the justice or propriety of the recommendation being made later.

CHAIRMAN ZIMMERSCHIED:—We would be very glad indeed to hear discussions on the points involved as desired by the committee, if there are any manufacturers or other interested parties present. As I understand it, the adoption of the first portion of the report is requested.

WILLIAM P. KENNEDY:—Yes, sir.

CHAIRMAN ZIMMERSCHIED:—If there is no discussion on this point, those in favor of the adoption of that portion of the report recommended by the committee will signify by saying aye; opposed. It is carried.

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SPEED AND MILEAGE RATINGS OF ELECTRIC VEHICLES*

CHAIRMAN ZIMMERSCHIED:—The report of the Electric Vehicle Division has a good deal in it that should be thought about quite carefully before it is finally adopted.

R. McA. LLOYD:—All of us are interested vitally as members of the Society in the prestige of the Society, and even if we are not specialists in some of these subjects that come up, I think we ought to be interested in the work that is being done by the Standards Committee and not let anything go through that we really do not approve. It is quite possible that some of the manufacturers who have given little consideration to this subject have agreed to this report, but my opinion is that it is not satisfactory from a technical point of view and should be referred back to the committee. Beginning with the speed and mileage ratings, it seems to me that the mileage rating is technically incorrect. The only thing that should be done is to specify as recommended practice, not as standard, that any rating should be based on certain load and road conditions, as stated here, but beyond that I think it is not possible to go.

The report reads, "Mileage ratings shall be based on the rated five-hour discharge capacity of the battery and a continuous run with one-half load over hard, smooth and level roads or pavements." You might as well for the gas car people draw a standard mileage that a car of given weight should go on a gallon of gasoline and call that the S. A. E. rating for gasoline consumption, and ask a manufacturer to put in his catalogue that his car will run so many miles on a gallon of gasoline, S. A. E. rating, while it actually could go many more. That is what the committee expect to be done in this case, as I remember the discussion in the Standards Committee meeting. Of course, the manufacturer need not put the S. A. E. rating in the catalogue and therefore it would not be used and the Society of Automobile Engineers would be putting out something that is absolutely impracticable, that no manufacturer would use and that would not be used by any purchaser, as it would be misleading.

On "Efficiency Tests of Solid Tires," I think that none of us knows enough about this kind of testing to say that any one instrument should be used for testing the efficiency of a solid tire. I believe that no purchasing agent would buy tires on these specifications. I do not think he would be satisfied to take the proposed S. A. E. standard test and order tires subject to this test. I do not think any tire manufacturer would take a contract for tires subject to such specifications.

"Number of Cells in Standard Battery Equipment." Here is one thing definitely stated: 42 lead and 60 alkaline. All that is really necessary if you are going to make any standard voltage is to stand-

†For report of Electric Vehicle Division, see January, 1915, BULLETIN, page 230.

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ardize the voltage of the motor. Here it is allowed more leeway, 80 to 85 and 60 to 66 volts. Anywhere from 42 to 48 cells are used with an 85-volt motor. I do not believe it is necessary to say how many cells a man should use with a car equipped with the high-voltage motor, because he will use the number of cells that will give him the most efficient current consumption in the locality where the car is to be run. If he puts in 42 cells he may throw away five per cent. of the energy which he is paying the light company for. Because when he is charging 42 cells with a 115-volt current he has to use more resistance all the time than when he is charging 44 cells.

This sounds like throwing a lot of cold water on the work of the committee, but I think our prestige is going to depend just as much on what we refrain from doing as on what we do, and perhaps more. I think this report ought to go back to the committee. I appreciate their efforts and realize they have a difficult problem, but think that the report should be in better technical shape prior to adoption.

W. P. KENNEDY:—I think from listening to the remarks of Mr. Lloyd that the best thing the Society could do is to send for the Electric Vehicle Division and tell them they do not know what they are talking about. Still this Electric Vehicle Division is made up of engineers of the best electric vehicle manufacturers, and their abilities are about the best the Society can command. If the engineers of the General Electric Company and the Westinghouse Company do not know what they are talking about when they make recommendations concerning motors, who does?

I take exception to almost everything that Mr. Lloyd has said, because I think the report is first of all very well considered. He intimates it has not been well considered. It has been considered in every detail and discussed at length by the most capable men in the Society competent of passing judgment on these recommendations.

If mileage rating is to be determined upon we stipulate a measure or a method by which that mileage can be gaged. We lay particular stress upon taking the five-hour discharge rate of the battery. How can you measure a battery or how do manufacturers measure batteries if not upon the normal capacity or output? They all measure their output in terms of a certain number of hours' discharge. They say a battery will give so many ampere-hours on a five-hour or a six-hour or a four-hour discharge rate, as the case may be; and nearly all have adopted the five-hour rate. Consequently, we recommend for the measure of mileage that the normal discharge rate of the battery shall be a determining factor; or in other words the discharge rate shall be that for which the battery is designed. Assuming that if an electric vehicle is properly designed with reference to the battery, that battery will be employed which will operate the vehicle at the discharge rate that is considered to be the best in the judgment of the battery manufacturer. We all know that certain things can be stretched, so to speak. You can increase the

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speed, you can increase the mileage, by various departures in one direction or another. If you take an abnormal battery and put it into a vehicle for discharge below its normal five-hour rate, discharge it say, at a six-hour rate, you will get more mileage than if you discharge it at the five-hour rate. Therefore, considering what devolves upon us in recommending practice for the measurement of mileage, we decided to recommend just what the discharge rate shall be or in what terms the discharge rate shall be measured.

With regard to the number of cells in the battery, I do not think this conflicts in any way with the voltage rating of the motor. You may use 40, 42, 44 or 48 cells. We recommend practice that is desirable. Because so many manufacturers use 40, 42 44 (and in the past used 48), some using 30 and 28 and so on, it is within our province as a committee, obligated with the duty of recommending practice to the Society, to determine what is the most desirable, and after due deliberation, we, as I say, competent engineers on the subject, have come to the decision of recommending 42 cells and 60 cells. Therefore, I think that the report ought to be accepted by the Society.

C. B. WHITTELSEY:—I am familiar with the rebound tire test recommended, having tried it for several years. I think it is dangerous, Mr. Chairman, to have this test standardized at this stage, for several practical reasons: first, that the tire companies manufacturing solid motor tires have been unable with all the skill at their command to arrive at a good method of testing tires for electric vehicles. I believe that the tire manufacturers have not yet a standard way of testing except with a current consumption machine.

Mr. Whitney sent me a blueprint of his instrument several years ago. On account of the impracticability of leaving the making of the tests to the purchasing agent or to a man not familiar with the manufacture of tires, it is quite impossible to make a test sufficiently practicable to determine whether or not a tire is best for an electric vehicle. The Whitney instrument is not sufficiently developed; it is not sensitive enough. It is a tube with a hammer dropping in it. If the operator does not hold it absolutely upright the friction of the hammer dropping through the tube is increased and the test spoiled.

In view of the long experience I have had with tires, and inasmuch as some others of the large companies in the same line have not been able to work out anything practical to the tire manufacturers' satisfaction, I would like to see this report if a rebound efficiency test is to be included in it, not specify this particular instrument. We have developed an instrument of this type, in which a ball is dropped through a tube when released mechanically. It drops down absolutely straight and registers on a recording dial. Judging the rebound by the eye is absolutely unreliable.

The temperature of the tire is something that I think should

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also be discussed thoroughly with at least the large tire manufacturers in this line, and I believe it has not been.

It hardly seems practicable for us as a body of engineers to adopt this report at this time, and I would like to see it referred back to the committee or the part referring to tire testing omitted.

E. R. HALL:—I concur with Mr. Whittelsey's remarks in reference to the efficiency test of solid tires, but also note a few points as to which I think that the tests suggested would not work out satisfactorily. For instance, current practice in truck tire design gives us some tires with flat treads, and some with crowned treads. Manufacturers claim that the physical cross-section of the tire has a lot to do with the elements of efficiency and wear. How are we going to apply this test satisfactorily to both crowned and flat tread tires?

It is also questionable whether the results obtainable from the test would be any criterion of the efficiency of the tire. For example, you may take two tires of two different compounds; compound *A* being a stiff compound and compound *B* a somewhat softer compound. With compound *A* you are very likely to get a higher rebound with the suggested test. Under smooth road conditions tire *A* will give better efficiency than tire *B*. As a matter of fact, the more nearly the steel band tire on a smooth surface is approximated, the higher the efficiency, and of course the less power the tire will consume. On an uneven road where the tire has to absorb unevenness, tire *B* will show up better than tire *A*, because it has the ability to drink up obstructions and the motor does not have to lift the vehicle over them. In such a case the scleroscope would not be a criterion.

J. R. C. ARMSTRONG:—Mr. Chairman, I think Mr. Kennedy has covered the subject fully on behalf of the Division. I think there is nothing further to say except that the idea of the second paragraph under the heading of "Speed and Mileage Ratings" was to get some basis for a mileage guarantee; in other words to define what a certain vehicle mileage meant and on what basis such mileage was obtainable. For instance, a battery is rated at a certain ampere-hour output at a certain discharge rate. This battery can be worked up to 20, 25 or 30 per cent. above its normal capacity and a corresponding increase in vehicle mileage obtained.

To avoid possible complications due to one manufacturer giving a vehicle mileage guarantee based on the normal output of the battery, and another manufacturer giving a vehicle mileage guarantee based on working up the battery above its normal capacity, it is thought advisable to recommend for adoption a definite battery capacity which should be based on the five-hour discharge rate.

By adopting the second paragraph under the heading of "Speed and Mileage Ratings," all manufacturers could give a mileage guarantee on the same basis.

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CHAIRMAN ZIMMERSCHIED:—As to the efficiency test of solid tires, I can only speak from experience with analogous tests. In applying two tests to steel both of which utilize the principle of the drop hammer we have found that the results are influenced so widely by variables which enter into the conditions of these tests that we must say we cannot see how a great degree of concordance can be expected from a rebound test on rubber in the case of which these variables would seem to be much more numerous, and harder to control. We have had no practical experience with this specific test however, and are not partisan in the matter.

Are there any other remarks on the subject?

W. L. BLISS:—Under the caption "Motor Voltage," the report reads, "The Division recommends the adoption of two classes of motors"; then it says, "One series designed for 80- to 85-volts operation," and then a little further down "the second series to be designed for 60- to 66-volt operation." When I first read this statement I thought the word "series" referred generically to the "series motor," and I hurriedly looked further on for the corresponding expression "shunt." Then I discovered that the word series really meant class. Therefore, I suggest that the word "series" be replaced by "class" or "classes," that is, one class designed for 80 volts and the other for 66 volts, to avoid using the word "series," which in this particular case leads to a little ambiguity.

R. MCA. LLOYD:—I move that the report be referred back to the committee for such revision as may have been suggested to it or as they may see fit to make.

(The motion was seconded.)

CHAIRMAN ZIMMERSCHIED:—Those in favor of this motion please signify by saying "aye"; opposed, like sign. It is a vote.

(Vice-president Wall assumed the chair.)

PNEUMATIC TIRE STOCK SIZES*

CHAIRMAN WALL:—The only question with regard to the recommendation of the report of the Pleasure Car Wheels Division is how soon and whether it can be carried into effect. It would mean a saving for all of us and would be of great advantage. The principal addition to this report, as you will note, since the summer meeting, is that of the 36 x 5 tire size.

E. R. HALL:—We cannot take much credit for this report as it simply shows the trend of the times; that is, it seems to be the tendency for vehicle manufacturers to work into this list with their tire specifications. As to the tire manufacturers producing tires that are not listed in the report, I presume that as long as they see any business in other sizes they will meet the trade. But it is certainly

*For report of Pleasure Car Wheels Division, see January, 1915, BULLETIN, page 247.

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their desire that all shall work together for the small list recommended in this report. We feel sure that the desired results will be realized ultimately. The tire manufacturers know from their study of tire wear and tire history that the diameters we recommend in the various cross-sectional sizes are by far the best diameters as far as satisfaction with the tires is concerned. The 36 x 4, for instance, is not as good a tire as the 34 x 4, or as the 32 x 4.

B. B. BACHMAN:—As I understand, no change from the current practice is recommended in any of the sizes other than the 36 by 5. It seems to me that the point upon which the adoption of the report will hinge, is whether the rim and tire manufacturers are in a position to furnish that new 36 by 5 rim and tire.

E. R. HALL:—I am not in a position to say that the rim manufacturers and the tire manufacturers have absolutely agreed on this 36 by 5 rim. The matter has passed already through the engineering and executive committees of the Clincher Tire Manufacturers' Association. It is now being put to a mail vote, and I think there is no doubt about the outcome. Immediately the new contour is accepted, the rims will be available. The tire will not be a new tire. The present 36 by 5 tire will fit perfectly on the new 36 by 5 rim, in both clincher and straight-side types.

HOWARD MARMON:—I move the adoption of the report.

(The motion was seconded, put to a vote and carried.)

ROD AND YOKE END PINS*

CHAIRMAN WALL:—The first item of the report of the Miscellaneous Division is on the rod and yoke end pins.

H. W. SLAUSON:—I move that this portion of the report be accepted.

(The motion was seconded, put to a vote and carried.)

STANDARD PITCH THREAD ABOVE 1½" DIAMETER*

CHAIRMAN WALL:—The next part of the report is the thread pitch standard above 1½" diameter. Is there any discussion on this?

(Upon motion, duly seconded, it was voted that this portion of the report be adopted.)

FLAT FAN-BELT WIDTHS*

CHAIRMAN WALL:—The last recommendation of the report is in regard to flat fan-belt widths. You will notice that three maximum widths are specified: ¾", 1" and 1¼".

*For report of Miscellaneous Division, see January, 1915, BULLETIN, page 234.

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JOSEPH A. ANGLADA:—I would like to have that word "maximum" explained. It does not mean anything to me.

CHAIRMAN WALL:—It is used to signify the plus tolerance. The committee decided it was better to make nominal width maximum, so that the 1" belt, e.g., could vary from one inch down but not be larger.

JOSEPH A. ANGLADA:—I believe that the usual practice of specifying plus or minus limits should be followed.

CHAIRMAN WALL:—What should the limit be?

JOSEPH A. ANGLADA:—I think it should be liberal. I would suggest 1/16". As it is, the belt maker might make a 1" belt ¾" wide. There is nothing to restrict him.

E. E. WAITE:—In fabric belts it is almost impossible to keep uniform the tensions of the shuttles that put in the filling thread. This determines the width of the belt, which may vary as much as 1/16" in a belt a foot long. In a longer belt the variation is liable to be almost ⅛", especially if a knot is passing through the shuttle. Wherefore, I think 1/16" would be too small a limit for fabric belts.

JOSEPH A. ANGLADA:—I move, that the part of the report referring to belt widths be referred back to the committee for further consideration.

(The motion was seconded, put to a vote and carried.)

SPARK PLUG SHELLS*

G. L. MOSKOVICS:—The recommended extension of the S. A. E. spark plug shell standards involves the addition of a shell which shall be 1 1-8" across the flats, to accommodate the large porcelain spark plugs which are coming out. The present S. A. E. standard ⅞-18 shell is retained with refinements.

Standard limits have been recommended for the thread of the spark plug and its tap, such that even with the maximum tolerance of the spark plug and the minimum tolerance of the tap hole, there shall be enough looseness in the threads to permit the spark plug to be screwed down by hand, the tightening being done by the wrench entirely; which makes it easier to remove and replace spark plugs and prevents freezing to a certain extent.

The tap drill size has been so selected that a 13/16" drill, .8125", or even oversize slightly, .813", can be purchased and used with the tap until it is worn down to .810", obviating the necessity of buying special tap drills.

The spark plug shell recommendations were adopted by the Standards Committee at its November meeting and have never been submitte before at a meeting of the Society for approval, together with complete drawings.

(Upon motion, duly seconded and put to a vote, this portion of the report was adopted).

*For report of Miscellaneous Division, see January, 1915, BULLETIN, page 234.

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ELECTRICAL EQUIPMENT DIVISION REPORT*

A. D. LIBBY:—Mr. Chairman, I would like to ask Mr. Bijur, when he is speaking of ferrules, if he had any particular kind in mind? It is ordinary practice in electric lighting work to use a lead ferrule in connection with flexible metallic conduits.

JOSEPH BIJUR:—No, I think we did not have any particular kind in mind. The ferrules used on conduits for automobile work seem to be the same soft steel as the conduit, with rounded edges to avoid cutting the insulation.

A. D. LIBBY:—I would like to ask what reason the committee had for recommending a switch in the ground connection. What is its purpose?

DR. R. H. CUNNINGHAM:—I would like to ask Mr. Bijur why the positive side of the battery is grounded in grounded systems?

A. W. COPLEY:—I would suggest that we specify that the point where the ground connection is made be not only clean and free from oxide or paint, but also be tinned.

JOSEPH BIJUR:—In regard to the switch, I think that is only a misunderstanding. The intention is to make the ground detachable, and the provision for the switch is made only in case the ground is not detachable. The report reads under "Grounding, " "Starting circuits should be run independent of 'ground' unless a substantial switch is placed in 'ground' connection circuit in an accessible place. The storage battery should be 'grounded' on the positive side and by only one conductor." Further, "This ground connection should be made in an accessible place by not more than a single screw or nut" (that would make it detachable), "or shall be made readily detachable by means of an accessible switch."

The idea was that the storage battery ground could be disconnected and in case a single screw or nut were not used, but instead a multiplicity of screws or nuts, a switch should be provided for opening the grounds.

In regard to grounding a storage battery on the positive side, there is little or no reason for grounding it on one side in preference to the other, but ignition practice, as well as practice in the automobile art in general, seems now to tend toward grounding on the positive side, and we thought our recommendation would make for uniformity. For ignition the ground on the positive side is considered better than a ground on the negative, on account of wear on the spark plug points.

The suggestion in regard to tinning, as far as I personally know, is a very good one and would seem to be the best way of insuring that the cleaned surface would remain clean.

DR. R. H. CUNNINGHAM:—A number of ignition systems have

*For report of Electrical Equipment Division, see January, 1915, BULLETIN, page 220.

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positive high-tension leads—in fact, in ours we so wind the coils that we make the high-tension wire from the coil positive, because when that is positive we find we get sparks at very much slower speeds, and we also notice with high-tension magnetos that when the high-tension wire is positive there is a sparking difference of ten or fifteen revolutions in favor of the spark plugs with the insulated electrode connected to the positive. So while I am aware that some of the companies do advise grounding the positive, I cannot see how it is of any value as far as the wear and tear of the spark plugs is concerned. If we have two spark plug points it is very much better, as far as the ignition goes, to make each high-tension insulated lead positive.

A. W. COPLEY:—In that connection the ignition systems as a rule are designed to make the high-tension side negative when the positive side of the battery is grounded. There is a hot point always on the negative terminal of the spark plug, and when that is made the high-tension side instead of the ground side, we are always sure of having that hot point concentrated on the plug. If the high-tension is made positive the discharge takes place not only to the ground side of the spark plug but also to other parts of the cylinder, and the hot spot is then so diffused that we do not get the good ignition that obtains with the high-tension side negative. If the battery is reversed on systems already designed the inevitable result is that we do not get quite as good ignition. So the positive ground, I think, is a good recommendation and should be universally used.

A. D. LIBBY:—Mr. Chairman, I may be a little dense, but I did not catch Mr. Bijur's point as to why this switch is put in. He stated it was put in to take the place of something not bolted on properly. There is a circuit, including the starting switch, from the battery to the motor. Now why put a switch in the lead from the battery to the frame of the car?

JOSEPH BIJUR:—If the starting circuit is not run independently and the starting current is then run through the frame and the battery is grounded to the frame in such a way that it cannot be detached, it prevents the desirable precaution of disconnecting the battery from the system, when making electrical repairs. That is practically the sole purpose of making the battery ground detachable. When connected with heavy cables to the frame without being detachable, any one making repairs to that circuit is working between the live conductors and the live frame, and thereby, of course, the liability of accidental short-circuit is greatly increased. So as a protection we thought it would be a desirable thing to have the battery ground always disconnected when making electrical repairs.

A further point is that if all precautions fail and the circuit is being overheated or the insulation starts to catch fire, it should be easy to break the circuit by disconnecting the storage battery from the frame. So both of those things influence us in saying that the

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heavy ground between the battery and the frame in the starting circuit, should be made so that the battery could be disconnected.

A. W. COPLEY:—In regard to the grounding switch on the battery, it does not seem to me to be desirable, because if the switch is opened while the engine is running, with very many generators the voltage generated will rise to quite a high value, 25 or 30 volts on a 6-volt system. If the ground connection is left off after making repairs, there is danger of overheating the generator or burning out lamps, as well as the diasadvantage of not getting the battery charged. If the ground connection is made so that it can be easily disconnected by taking out a bolt, a man will be less likely to forget to replace it than he will with a switch. I think a switch is rather a bad proposition, and even the easily removable ground has its disadvantages in comparison with a permanent solid ground connection.

A. D. LIBBY:—I move that the report be accepted.

(The motion was seconded, put to a vote and carried.)

(Vice-president Zimmerschied assumed the chair.)

FRAME SECTIONS*

W. G. WALL:—Mr. Chairman, while I realize that the Frame Sections Division report is one of progress to a great extent, I notice that no account has been taken of the double-drop frame; and while I believe that just as good a frame and just as good a car can be designed without the use of a double-drop frame, at the same time there are a large number of manufacturers using this, and it seems as if the committee should take some account of it. It may be that they expect later on to give us a further report on this.

J. G. PERRIN:—There will be undoubtedly questions like that raised continually, as changes in design are made. The whole thing, of course, is determined by the demand for various shapes of frames. Further reports can probably be added from time to time as the industry progresses.

DAVID LANDAU:—I would like to ask Mr. Perrin if anywhere in the standards of the Frame Sections Division there are any recommendations regarding the permissible loads on the channel sections as specified in the report, and when they are made of various materials. It seems to me that a draftsman, for example, laying out a frame, would hardly appreciate fully the significance of the depth or width of the channel with respect to the load he is going to impose; and analogously, as in standard railroad practice, where the depth, width and thickness of material are as important as they are here, there is some definite specified loading for the section in question. Now it seems to me that not knowing how much load the channels will carry as proposed by these standards, leaves us in a position

*For report of Frame Sections Division, see January, 1915, BULLETIN, page 224.

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where we may find a standard frame under a touring car and a similar channel placed under a very heavy limousine.

J. G. PERRIN:—That point did come up. As I said before, this report cannot be a treatise on the design of frames, on account of the infinite number of points that would have to be covered. Of course there could be figures giving the carrying capacity of varying sections of frames in regard to static loads with varying distances between supports. The depth of frame is many times governed by other questions besides strength, such as the matter of body squeaks. It is a question of rigidity rather than ultimate strength that is most important a great many times. So that merely the physical ability of the frame to stand certain static loads would not always be the proper information for a designer who is laying out that frame. Such information, of course, would be valuable. I think it would be valuable for the data book to have things of that sort merely as a means of reference.

CHAIRMAN ZIMMERSCHIED:—It would appear that the spring suspension should also be considered. There are a great many variables which determine how a frame should be built and one of these would certainly be the distribution of the load and the type of springs.

W. G. WALL:—I move, Mr. Chairman, that the report be adopted.

(The motion was seconded, put to a vote and carried.)

COKER F. CLARKSON,
Secretary.

Note.—The reports as accepted of the Iron and Steel Division and of the Standards Exchange Division and the discussion of the same at the 1915 Annual Meetings of the Standards Committee and of the Society will be printed in a later issue of the BULLETIN.

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Presented at Detroit Section Meeting.

THE COMMERCIAL SIDE OF THE HEAT TREATING PROBLEM

By R. E. VINCENT*
(Member of the Society)

In the heat treatment of plain open hearth steels, I believe that the nearer one can reach the critical point of the steel in its heating, the better results one will get. Some people think that two quenching treatments are necessary. I do not, when the composition of the steel is known accurately. I believe that one quenching treatment will give all that is to be had out of a particular steel. The higher carbon steels do not require the heat that the lower carbon steels require. It should be borne in mind that steels do not run uniformly as to composition in many cases. In rear axle shafts we have treated we have found a variation in the ends of a single bar.

The alloy steels are somewhat different. I believe that the temperatures can be lowered considerably as compared with the case of the open-hearth steels and the results looked for obtained.

Not long ago we made a test of ten separate bars, running them all at one quenching treatment, and spacing about every 50 degrees apart in the drawing. We had ten pieces made and tested. There was a considerable variation until we reached the drawing from 850, 900 and 1,000, when they ran very uniformly. That is, we found that drawing back at 900 gave the best results, about 120,000 pounds tensile strength, 75,000 elastic limit, reduction of area 48 per cent., and elongation 24 per cent.

The quenching treatment of alloy steels should be lower comparatively. If the composition of the steel is known, one can come pretty close to the critical point. We are not in a position to work as closely, I think, as a man who is treating one metal, or as near one metal as he can get, day in and day out. We get some of this and some of that. I have found many cases of people not having what they ordered, what their specifications called for. I have been in the heat treating business about twenty-four years and find that the longer I am in it, the less I know about it.

GEARS

I believe that the greatest problem the man in the heat treating business has to contend with is gears. I sometimes think that people in ordering drop forgings do not start far enough back. The forge man

*General Manager and Superintendent, Vincent Steel Process Company.

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has as much to do with producing a good drop forging for a gear blank as any man connected with it. The forging is not done at a uniform temperature. It is not watched closely enough. Production is the one thing looked for; if two or three blanks can be made from one heat, this is done; it is certain that the forging temperature varies. It is said that heat treatment will make the forgings absolutely uniform. I think it will, but the treatment must be uniform, must be watched closely, or the forgings will not be any better than they were before. This has a great deal to do with shrinkages and distortion in hardening. Pyrometers do not tell us all. They will tell possibly the furnace temperature, but it is up to the workman to know that the gears or parts are as hot as the pyrometer indicates. I have yet to see a furnace that will heat a number of pieces at one time, in a commercial way, absolutely uniformly, so that they all come out at the same time in the same way. The operator must sort and pick the work out when the time comes.

The rear axle bevel gear is one of the most difficult things we have in the gear line. As I understand, from 75 to 80 per cent. of the forgings are made out of flat steel which is split in the center and drawn out into circular form to make a forging. I think this is entirely wrong, for the grain of the metal runs both ways; it is all right one way and all wrong the other. When you come to harden or treat the gear, if it is a carbonized gear, a distortion will take place, due, as I can see it, to the forging of the gear. I do not pretend to be a drop forge man, but I believe far better results would be obtained if a piece of steel 4 inches or 3 inches in diameter, or whatever may be required, and 4 inches or 5 inches long, were taken, set on end, and flattened down to a reasonable thickness, and then punched and spread out. The grain of the steel in the teeth would be running in one direction. I feel quite sure this would eliminate possibly 60 to 75 per cent. of the distortion in hardening. The time to heat treat the blanks is after rough-machining. They may be thoroughly annealed after the forging, but they should go through heat treatment after rough-machining, because strains are set up in machining, which cut considerable figure in holding the gears true in hardening.

Some firms have jigs in which they clamp gear blanks tightly while they quench them. I have done that in rather a crude way, but have never been able to see that it did any good. In some cases we could hold the gear absolutely true, while we had it in a jig, but the minute we took it out, which we had to do, we found that a change took place, which is most natural, because in hardening the gear in the fixture the quenching or cooling is certainly uneven. A whole lot can be done in the forge shop to eliminate trouble in the gear line. I believe that the gear hardening question is the biggest problem you have before you to-day.

HARDNESS

In the case of open hearth steel gears I believe that the engineers specify too high degrees of hardness. It is hard to make a gear that

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will stand all people's usage. In most cases a scleroscope reading of from, say, 75 to 85 is asked for. I think that too hard for a sliding gear. There is a question whether it is best to have a gear break or wear out. To get gears as hard as indicated above leaves the steel on the brittle side. Scleroscope readings from 65 to 75 on open hearth steel gears that are to be used by sane persons, will give longer life, with better results. The gears will not be file-hard and I think they should not be.

We may drop the scleroscope reading down considerably on a gear that is made of alloy steel. I think that an open hearth steel gear should never be used as a sliding gear. Where gears are running in place, I think it is all right possibly in many places. With almost any of the alloys you can drop down 10 to 15 points below what you can with an open hearth steel and still have a gear that will stand up.

Some of the engineers specify a scleroscope reading of from 90 to 95 for a tappet. That is a pretty hard thing to get with open hearth steel, of which most tappets are made, and at the same time have a tappet that will wear. You get a grain in the steel that, after it is used a little while, brings a tendency to crumble away, because you have to use a temperature beyond that which would refine the metal and leave a close grain. I believe that better results are obtainable from tappets with scleroscope readings of say 80 rather than higher than that.

THE SCLEROSCOPE

The scleroscope is a hard thing to follow up, that is, if you depend upon it. I find that it is very deceptive, that there are points about it that I cannot master. If there is any gentleman in the room who can enlighten me, I would like to hear from him. For instance, we have two of the instruments in our institution. I have taken one of them at night, tested it out on my test block, and it read right up to test; and the next morning it read 15 points low on the same block and in the same position. I am at a loss to know why that is. There is a reason for it, but I cannot see it. I notice that in other cases in testing gears and other parts the instrument does not give the true hardness. I believe the instrument indicates more the true density of the metal than the hardness. Take two pieces of steel, one a straight open hearth steel and one a nickel alloy, and put them under a Brinell test. The Brinell tests are just about the same. Put the two pieces under a scleroscope and I believe you will find a considerable difference; the more dense the steel the higher the reading will be. You can prove it on a gear. We will take a straight cut gear for instance, with a 3/8-inch web. We will get a higher reading right over the web than on either side of it. I would say that the piece is harder on the ends or out at the edges by from five to ten points than it is in the center. The scleroscope says it is the other way. In many cases I have seen men in the inspection department testing out gears who do not consider the difference.

I believe in treating all metal in view of the purpose for which it is

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going to be used, as nearly as possible. The man in charge of the hardening room should know; nothing should be kept from him in regard to what is looked for and the results he is getting. He should know the history of the whole thing from start to finish, in order to get the best that can be had.

DISCUSSION

HENRY SOUTHER:—I want to put in a plea for the reliability of heat treatment. An impression has probably been left by Mr. Vincent's talk that heat treatment is an uncertain thing. I believe he has permitted himself to think of the exception rather than the rule. In recalling personal experiences over a period of many years in treating gears or bearings, the routine of work has been carried out by the men about the plant, absolutely routine. My time, as well as my assistant's, has been used to take care of the exceptions. In other words, when the work went smoothly there was no need for help, or any technical assistance. I suppose that there have not been ten or a dozen cases a year in connection with ordinary routine work where my attention has been called particularly to a problem. In other words, the bulk of the time good honest heat treatment produces uniform results. That is one thing I want to make very clear, if possible. We are all likely to remember the exception, the interesting thing, the problem that excites our ingenuity and makes us work; we remember such cases very clearly. But just think of the uniformity that is obtained by careful work. Hardening or heat treatment in some form is an absolute necessity in the automobile industry. To do without it now would be an impossibility without changing every thought we have. To put up a set of bearings, without hardening or heat treatment, could not be done. Think of the rule, not the exception. Think of the splendid uniformity that is obtained by good commercial hardening methods.

Mr. Vincent mentioned one thing that is an exception, and one that ought to be borne down upon. That is whether or not one treatment is sufficient. My answer to that problem is: for most cases, yes. On the other hand, unless the previous history of the piece treated is known, it is more dangerous to single-treat than double-treat. In other words, double treatment when properly conducted will obviate previous bad treatment. Take an average overheat, for example. If the first treatment has not been of the right quality, the second treatment will produce good results. Assuming the piece to have been forged properly, one treatment will produce substantially as good results as two. That is very true of the very high carbon steels, like steel used for bearings, as most of the bars of such steels will respond to one treatment. Some bars absolutely will not respond to one normal treatment. The result is that if such a bar be discovered in time, the double treatment is an absolute necessity to get good results. In some of the German bearing factories this is recognized and double treatment is uniformly used, with the idea, I believe, of taking care of stock bars or materials

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which have had a bad history; perhaps overheated during forging and under-annealed during annealing.

Mr. Vincent has rightly said that the scleroscope is a delicate instrument. For direct comparisons it is very good. For highly polished surfaces it is the only thing that can be used that I know of. But it must be remembered, as I have said again and again to members here and in other places, the surfaces must be uniform, the volume must be uniform, the angle must be normal, the inside of the tube must be clean, and the point of the little projectile or whatever you call it must be watched; all those things must be taken care of. Take the steel ball for a very good illustration. A 1-inch ball properly hardened is uniformly about 100 hard; a ⅜-inch ball about 50 hard. A straight line drawn between the two will find all the other balls, all the intermediate sizes, very close on the line. Then, curiously enough, the smaller, ¼-inch, ball is harder on the scleroscope than the ⅜-inch. Just why that is I am not sure, but I have always felt that the ¼-inch ball was so small in volume that the anvil effect of the supporting material was of more influence than the hardness or volume of the ball itself. Then at ⅜-inch came a turning point where it was nip-and-tuck whether the ball or the anvil was of most influence; from that point up the anvil effect of the ball itself was the controlling influence.

Anyone who tests balls by the scleroscope will find out very soon that there are no balls ½ inch in diameter that are 100 hard. I understand that a holding device has been brought out of such a weight and character that it grips any size ball tightly and gives the uniform hardness for all sizes, but there again is the influence of the holding device and the anvil affect of it. But taking the instrument as it is furnished, and putting a ball under it as carefully as possible, there will be a vast difference between the hardness of the ½-inch ball and the 1-inch ball.

In closing I want to say again that an immense amount of uniformity and certainty is obtainable from ordinary commercial heat treating operations. I think that is proven by the fact that millions of pieces, including gears and bearings, are giving uniform service and that the exception is the one that does not.

H. W. ALDEN:—I think that Mr. Vincent, as Mr. Souther has said, has perhaps exaggerated the uncertainities due to the exceptions rather than the rule. He is perfectly right in one thing, however, and that is that the forging of the original blank, so far as gears are concerned, has a very great influence on the subsequent work on that gear blank. It is something that is very easy to understand, I think. All of us are more or less familiar with the grain structure of steels, and with what happens in the subsequent treatment.

UNIFORMITY

Perhaps in a business such as Mr. Vincent's, in which he gets in some of this and some of that and something else, he is working under very much more disadvantageous conditions than a concern which is

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running along on a given and known product. The most important single item in proper heat treatment—this may sound like a very flat statement, but it is the case—is uniformity. That is something like saying two is two, but it is very hard, very hard to control and govern. It is the most important thing. It does not make such an awful lot of difference, within reasonable limits, what you do, if you keep on doing the same thing all the time. Get a reasonable amount of good results out of your method, and then keep on doing the same things the same way all the time. I think Mr. Souther, and anybody who has had intimate contact with heat treatment work, will agree with me that the hardest thing to do is to get the methods of production such that uniformity of work results all the time. Work out theoretically and practically the results you want to get, and then establish your limit both sides of that, and try to keep things in the middle of the road. And there, with all due respect to the shortcomings of the scleroscope, the scleroscope is of very great assistance. I am not prepared to say that the scleroscope is an actual indication of hardness. As Mr. Souther says, the scleroscope would show the ⅜-inch ball to be 50 hard and the 1-inch ball 100 hard, but if you have previously found out that the ⅜-inch ball which the scleroscope tells you is 50 hard will produce the results you want in your bearings, then that same scleroscope will tell whether all of your balls are 50 or something else, and that is what the scleroscope is for. If you use the scleroscope with that in mind, producing comparative results only, you are all right. Take two forgings, one a large one and one a small one; with exactly the same treatment, exactly the same steel, the scleroscope will show one reading on one and another on the other. You have to find out first what condition the steel should be in to get the best results; find out from the scleroscope and your experimental readings what the scleroscope says, and then thereafter follow approximately the scleroscope readings. The scleroscope will pick out the good forgings and the bad ones practically every time.

FURNACES

I think furnaces are produced to-day, at least for certain grades of material, which will turn out practically automatically absolutely uniform results. You can run through a million parts if you want to, and that million will be practically and substantially alike. It is possible to build furnaces that will turn out gears with three or four in the furnace at the same time, all of which are absolutely alike; you cannot tell one from the other, I believe, by any known methods of investigation.

It may interest you to know of one little attachment that we put on an electric furnace at our plant for the heating of gears. The same thing would be applicable to the oil-fired or gas-fired furnace. It is difficult if you simply place gears in the furnace to get them uniformly heated. We ran a shaft up through the bottom of the furnace with a fire-clay head on it, and the gears or the part to be treated are mounted on that, and are rotated in the furnace at a reasonable rate of speed so that the different parts are exposed to the resistance on the side.

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When they come out, they are all alike, there is no question about it. If there are six pieces in there, or ten pieces, you may be sure that they are all exactly alike.

MR. BOURG:—Bringing up the subject of gears again, Mr. Vincent spoke of the heat treatment of the forgings after the rough-machine work. I would like to ask which would be the best treatment to apply there, an annealing from just above the critical temperature, or a quenching and an anneal before the final machine operation?

R. E. VINCENT:—I would say a quenching above the critical point, then draw back and anneal afterwards.

MR. HEILMAN:—I have never seen a furnace that would work absolutely uniformly, but we have obtained good results by having our hardener watch the gears very closely, and when they are of the same color, as near as he can tell by his experienced eye, as his pyrometer notes, pull the gears out around the pyrometer end. We usually find the ones in the front of the furnace are slightly colder, and we work these towards the back of the furnace, and as they come up, pull them out. In that way we get our results very uniform.

I made a test a couple of years ago on steel of different thickness, not in spherical section but flat section, and found a point where the minimum scleroscope results were secured, usually about 9/16 inch on the flat steel.

MR. LAWSON:—I would like to ask whether, in heat treating bevel gear blanks before machining, quenching would be any benefit, particularly if there is going to be a similar treatment after the gear is rough-machined, or whether there should be just an annealing process to take the strains off, and then the heat treatment after the rough-machining?

R. E. VINCENT:—I think the annealing process is sufficient after forging. Then after rough-machining, quench and anneal, leaving the steel in a condition in which it can be machined readily. With a low carbon open hearth steel a water quenching is better than oil for that treatment. I believe you get all the distortion right there. Then you true the gear up in the finishing operation.

E. F. LAKE:—It is only within the last few years that we have realized that accuracy is of the utmost importance in hardening and tempering steel. Some ten years ago builders of furnaces used to make the claim that their furnaces would heat within 40 degrees of a given temperature in the different parts of the furnace, and that was considered very close work. To-day there is hardly a furnace builder in the country who does not claim he can build furnaces 6 and 7 feet deep by 3 and 4 feet wide, and keep the temperature within 10 degrees of a given point in any and all parts of the heating chamber. This has been brought about by numerous investigations that have been made in the last decade, which have shown that accurate hardening and drawing temperatures always give the best results in the heat treatment of steel. Numerous tests have shown that the elastic limit varies some ten or fifteen thousand pounds per square inch with a variation of 50 degrees in the hardening temperature. They have also shown a similar percentage of

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variation in the fatigue test. Such a variation in temperature was allowable ten years ago, but to-day we get down to a variation of but 5 or 10 degrees in good work, with the aid of various instruments and apparatus such as the pyrometer, the electric furnace, the automatic-temperature-control instruments, which it is claimed will keep the furnace within a range of 5 degrees from any given temperature, the salt and lead bath furnaces, etc. In fact, the days have gone by when men who harden and temper steel by eyesight can get the results that are demanded for the high-class machinery, tools, etc., that are made at the present time.

The result has been that hardening rooms have been equipped with all the various kinds of furnaces, instruments and apparatus. Nearly all that scientific investigations have discovered in the way of methods, processes or apparatus is now applied commercially. Probably more of the scientists' investigations have been utilized in this field than in any other we can mention. The work, too, has been brought to a point where it is done almost automatically. One hardening room in particular hardens and tempers something like a hundred thousand pieces per day.

Ten years ago the work was done by eye by skilled men who were drawing from four to five dollars a day. To-day, after remodeling and equipping with modern apparatus, young men, drawing two and two and a half dollars per day, do more work, maintain more accurate temperatures, and turn out much better work than was done before. When steel is correctly heat treated we do not find so much fault with the steel makers for giving us poor steel. This shows that inaccuracy in hardening and drawing temperatures is often more at fault than is the poor quality of the metal.

CHAIRMAN E. T. BIRDSALL:—Is there any further discussion? Would anybody like to ask Mr. Vincent more questions? I would like to say that I agree with Mr. Souther and Mr. Alden that Mr. Vincent has noted the exceptions. I know that hundreds of thousands of pieces go through Mr. Vincent's place every week. He certainly could not have trouble with all of them or a number of them. I know I had ten thousand pieces go through his place recently, without having trouble with any of them.

R. E. VINCENT:—I did not want to create an impression that we had trouble with everything, but we do have trouble with some things.

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CHANGES OF ADDRESS OF S. A. E. MEMBERS

Charters, D. B., formerly engineer, Pittsburgh Model Engine Co., Pittsburgh, Pa.; now assistant chief engineer, Breitung & Co., Ltd., New York City.

Gmeiner, C. S., formerly assistant general manager and chief engineer, Dart Mfg. Co., Waterloo, Iowa; now consulting and designing engineer, Detroit, Mich.

Hall, C. M., formerly sales manager, Parish Mfg. Co., Detroit, Mich.; now connected with Wetzel Hall Co., Detroit, Mich.

Lynch, L. B., formerly plant superintendent, Studebaker Corporation, Detroit, Mich.; now vice-president and general manager, American Top Co., Jackson, Mich.

Seeley, S. Ward, formerly connected with North American Copper Co., New York City; now associate technical editor, **Motor Trades Publishing Company**, New York City.

Sheahan, Thos. W., formerly draftsman, Nelson Brennan Peterson, Detroit, Mich.; now a student in mechanical engineering, University of Michigan, Ann Arbor, Mich.

Stillwell, Wm. H., formerly sales engineer, J. S. Bretz Co., New York City; now in sales department, Detroit Division, Joseph Dixon Crucible Co., Jersey City, N. J.

Willis, Frank B., formerly Eastern district manager, Lozier Motor Company, Detroit, Mich.; now in sales department, Chalmers Motor Co., Detroit, Mich.

Wulf, F. C., formerly factory representative, Gray and Davis, Inc., Boston, Mass.; now engineer and superintendent, Paul M. Marko & Company, Brooklyn, N. Y.

APPLICATIONS FOR MEMBERSHIP

A list of current applications for membership is given below. The members are urged to send for the consideration of the Council any pertinent information with regard to those whose names are given which the Council should have prior to the election of any of the said applicants. It is requested that communications from the members in this connection should be sent promptly.

Bender, Frank M., Chief Draftsman, Lycoming Foundry & Machine Co., Williamsport, Pa.

Chapman, Lee A., Chief Engineer, Beaver Mfg. Co., Milwaukee, Wis.

Cleaver, Charles F., London, England.

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Glickman, Mendel, Tool Designer, Beaver Motor Mfg. Co., Milwaukee, Wis.

Goddard, Herbert A., Special Representative, Perfection Spring Co. Cleveland, Ohio.

Greer, Perry H., President, Greer-Robbins Co., Los Angeles, Cal.

Hendrie, William, Secretary and Treasurer, Detroit Gear & Machine Co., Detroit, Mich.

Liston, Joseph H., District Manager, Thermoid Rubber Co., Trenton, N. J.

Miley, Lewis J., Salesman, Thermoid Rubber Co., Trenton, N. J.

Ridley, Grahame B., Assistant to Chief Engineer, Heineman-Pearson Co., San Francisco, Cal.

Ridlon, John R., Repair Department Foreman, Locomobile Co. of America, Chicago Branch.

Seabury, Richard W., Treasurer and Technical Director, Boonton Rubber Mfg. Co., Boonton, N. J.

Smith, George E., Mechanical Draftsman and Designer, American Die and Tool Co., Reading, Pa.

Waite, E. E., Chief Engineer and Factory Manager, Standard Woven Fabric Co., South Framingham, Mass.

Welton, Spencer, Vice-President and General Manager, Rutherford Rubber Co., Rutherford, N. J.

Winther, Martin P., Truck Engineer, Thos. B. Jeffery Co., Kenosha, Wis.

APPLICATIONS APPROVED DURING FEBRUARY

MEMBERS

Coholan, Wm. T., 19 South High St., New Britain, Conn.

Gould, W. S., Gould Storage Battery Co., 30 East 42nd St., New York City.

Jack, Robert K., 326 High Park Ave., West Toronto, Ont., Canada.

Rhoades, Lewis T., care of New York Coil Co., 338 Pearl St., New York City.

Richmond, Everett E., Elco Company, Bayonne, N. J.

White, D. McCall, 142 Putnam Ave., Detroit, Mich.

ASSOCIATES

Campbell, Alfred L., 535 First Ave., Astoria, L. I.

Haines, William A., 170 West Warren Ave., Detroit, Mich.

Lemunyon, Ethan C., 523 Black Bldg., Los Angeles, Cal.

JUNIOR

Maloney, J. E., Hydraulic Pressed Steel Co., Cleveland, Ohio.

STUDENT ENROLLMENTS

Emmons, Walter, 792 Cass Ave., Detroit, Mich.

Lange, Joseph A., 50 Washington Ave., Clifton, N. J.

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OFFICERS OF THE SOCIETY

President, William H. Van Dervoort, Moline, Ill.

First vice-president, Frederick R. Hutton, New York.

Second vice-president, Joseph A. Anglada, New York.

Treasurer, Arthur B. Cumner, New York.

Chairman of Finance Committee, Horace M. Swetland, New York.

Secretary and General Manager, Coker F. Clarkson, New York.

MEMBERS OF THE COUNCIL

William H. Van Dervoort, Moline, Ill.
Frederick R. Hutton, New York.
Joseph A. Anglada, New York.
Arthur B. Cumner, New York.
Christian Girl, Cleveland, Ohio.
Henry C. Wilson, New York.
F. M. Germane, Philadelphia, Pa.
William P. Kennedy, New York.
C. B. Rose, Moline, Ill.
John Wilkinson, Syracuse, New York.
Howard Marmon, Indianapolis, Ind. (Past President).
H. M. Leland, Detroit, Michigan (Past President)

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SECTIONS OF THE SOCIETY

DETROIT SECTION

E. T. BIRDSALL.....*Chairman*
C. T. MYERS and W. N. OSBURN.....*Vice-Chairmen*
W. H. CONANT.....*Acting Secretary and Treasurer*

(Address) Kerr Bldg., Detroit, Mich.

Meets first Thursday each month at 8 p. m., in the Employers' Association Rooms, Stevens Building, Detroit, Mich.

INDIANA SECTION

LON R. SMITH.....*Chairman*
R. H. COMBS.....*Vice-Chairman*
CHAS. P. GRIMES.....*Secretary-Treasurer*

(Address) Wheeler & Schebler, Indianapolis, Ind.

Meets first Tuesday after first Wednesday each month at 8 p. m., at the Hoosier Motor Club in the Claypool Hotel, Indianapolis, Ind.

METROPOLITAN SECTION

JOSEPH A. ANGLADA.....*Chairman*
HERBERT CHASE.....*Treasurer*
NIRAN BATES POPE.....*Secretary*

(Address) 1790 Broadway, New York City.

Meets last Thursday each month, except July and August, 8 p. m., at the Automobile Club of America, 247 West Fifty-fourth Street, New York City.

CLEVELAND SECTION

JAMES H. HERRON.....*Chairman*
H. B. ANDERSON.....*Vice-Chairman*
A. J. SCAIFE.....*Treasurer*
R. J. NIGHTINGALE.....*Secretary*
E. R. HALL, J. H. HERTNER, R. H. MANSON.....*Members Board of Directors*

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POSITIONS AVAILABLE

The following announcements are published for the information of members of the Society. No charge whatever is made for these announcements. Members who wish additional information will please address the office of the Society.

204. Salesman for New England States to look after local dealers. Must be high-grade man who can get results on commission basis. We have a proposition that appeals to all men of ability in selling line.

207. A man capable of directing or assuming charge of entire inspection, from receipt of raw material to final car inspection.

*208. Die sinkers, experienced in automobile drop forgings.

*209. Concern manufacturing small electrical motors in quantities wants draftsman or clerk experienced in the standardization of product, parts as well as tools. Must be familiar with drafting room organization and systematic recording of standards. State age, references and salary.

*210. Large accessory manufacturing plant wishes to secure a good representative acquainted with the purchasing agents and engineers of automobile factories.

*211. Skilful draftsman in truck engineering department; preferably a technical graduate who has had some experience in designing motor trucks with a view to economical production and awake to modern requirements.

MEN AVAILABLE

0299. Engineer with experience peculiarly fitting him for the service, desires position with leading company to act as point of contact between engineering department and the service, sales, advertising and publicity departments. Can handle mechanical instruction of salesmen, write instructive books and aid in experimental work.

0300. With twelve years' active experience, can fill intelligently and efficiently position as road or home service representative for manufacturer of gasoline trucks. Employed at present.

0301. A graduate of the Texknowlgic College (Russia) seeks a position as first-class draftsman or parts inspector with an automobile factory or automobile accessory concern in the Middle West.

0302. Electrical and mechanical engineer, 33 years of age, 12 years' experience, desires to make connection with some firm as electrical or mechanical engineer or superintendent. Also has selling experience.

(*Concluded on page* 8)

*Send written application to S. A. E. office to be forwarded to employer.

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NEW DEPARTURE BALL BEARINGS

American Made for American Trade

QUALITY is the standard by which all bearings must finally be judged—quality of designing, of material, of manufacture and finish, of inspections and then—the Quality of personality or that intangible something which inspires confidence in manufacturer and product alike.

By reason of all its qualities — The New Departure has set a standard of excellence by which all other bearings must in due time be compared.

Our Engineering Catalog just issued was especially prepared for members of the S. A. E.

Send for a copy.

THE NEW DEPARTURE MFG. CO.

BRISTOL, CONN., U. S. A.

Western Branch, 1016-17 Ford Building, Detroit, Mich.

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ANNOUNCEMENT

Browne Carbureter

To meet the demand and to assist Engineers and Manufacturers in investigating or using the Browne Carbureter we have established a

WESTERN BRANCH OFFICE

in the

David Whitney Building

DETROIT, MICH.

and

Mr. C. Everett Manning

Recently Experimental Engineer of the Continental Motor Manufacturing Co.

Has been appointed

Technical Engineer

thereto.

HOLT-WELLES COMPANY, Inc.

E. H. Stickels, President

1790 Broadway, New York

ARTHUR B. BROWNE
Consulting Engineer

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Malleable Iron Fittings Company
Branford, Conn.
Manufacturers of Browne Carbureters

QUANTITY PRODUCTION

In adding a specially constructed four-story factory building to their already large plant, newly equipped for the manufacture of carbureters, the Malleable Iron Fittings Company, manufacturers of the Browne Carbureter, have provided every facility necessary for the production of carbureters of the highest standard of material and workmanship in any quantities required.

Theirs is an organization skilled in quantity production.

Thoroughness has been the watchword in the shop, and the resulting perfection of manufacture has become the company's distinguishing characteristic as to products.

SOLE SELLING AGENTS:

Holt-Welles Company, Inc.
E. H. Stickels, President
U. S. Rubber Building **1790 Broadway, New York**

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HAYES WHEELS GIVE SATISFACTION

We take continued and painstaking care with the little details of construction which typify the individual requirements of the customer.

Our well-balanced and strict system of inspection insures the maintenance of a uniformly high standard in material and workmanship.

Our capacity for large quantity production affords protection to the buyer who requires a steady, dependable source of supply.

WE WORK WITH YOU

Hayes Wheel Company

Jackson, Michigan

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The Elimination of the Cage in

THE GEORGE AUTOMATIC ROLLER BEARING

All Roller Bearings must provide some means for separating the rollers. The George Automatic Roller Bearing eliminates all cage troubles by using balls as separators. The balls and rollers come in contact at a point where true rolling motion takes place. This eliminates all friction between the movable parts and provides a perfect separator for the rollers. Further, the conical ends of the rollers, acting in conjunction with the balls, overcomes all tendency of the rollers to skew out of their true rolling axis.

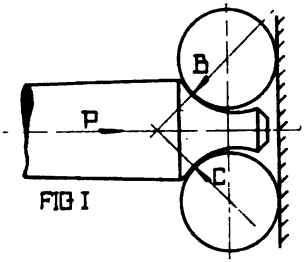

FIG I

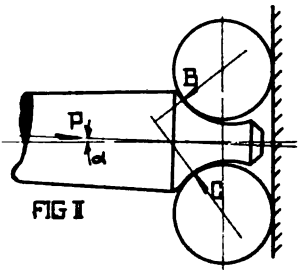

FIG II

Assume P Lbs. Fig. 1 and Fig. 2 to be the pressure on each roller of the bearing as the result of applying end thrust. The reactions C and B in Fig. 1 act along lines which make equal angles with the axis of the roller and therefore have the same magnitude. In this position the axis of rotation of the roller focuses at the same point as the axis of rotation of the cup and cone, thus giving true rolling motion.

Now assume that the roller could be skewed out of its axis represented by the angle α as in Fig. 2. The resultant forces B and C will act along lines which make unequal angles with the axis of the roller and as a result B will have a greater magnitude than C. This condition cannot exist as B will always be greater than the pressure tending to throw the rollers out of alignment.

A similar reaction takes place at the small end.

Other features of the George Automatic Roller Bearing will be described in later issues of the S. A. E. Bulletin.

THE GEORGE AUTOMATIC ROLLER BEARING CO.
Walter H. Miller, President **Hamilton, Ohio**

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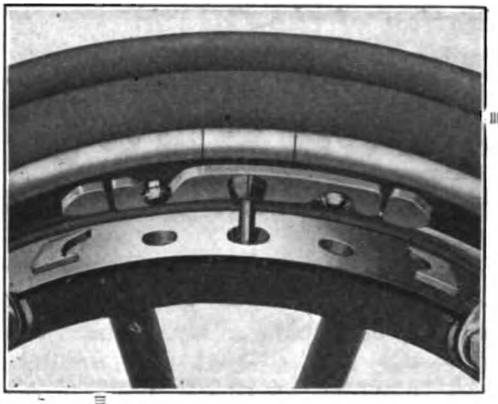

The Detroit Demountable Rim

The Rim that is Conclusively Mechanical

The arrow and "V"-block driving construction makes the Detroit Rim absolutely positive, and is the only demountable rim having this unique feature.

The cutout section of the Detroit Rim allows such freedom of operation in removing the tire that a pair of ordinary hands are the only tools—in extreme cases a small screw-driver is all that is necessary.

We claim for the Detroit Rim: strength, lightness, quality, economy and durability—a rim any novice can operate without the assistance of the "nearest garage."

We respectfully request the builders of motor cars to extend the opportunity of proving the worth of the above claims. Our prices are as interesting as our rim.

Jackson Rim Company

Jackson, Mich.

Exclusive Manufacturers of the Detroit Demountable Rim

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AIR TESTING MADE EASY

The operation of testing the air-pressure in tires having been found on occasion difficult and irksome by reason of the jamming together of the valve stem and dust cap, the firm of A. SCHRADER'S SON, Inc., have designed and placed on the market a new "Quick-Acting" dust cap which can be removed from the valve stem by a simple quarter turn.

The new SCHRADER "Quick-Acting" dust cap eliminates the work of screwing the cap down the entire length of the valve stem to the felloe of the wheel. All that is necessary is to slip the cap over the valve and turn it one-quarter turn. This locks it securely to the valve stem. To unlock, simply give one-quarter turn in the opposite direction. The locking device is composed of a thread made up of four sections. By pressing the dust cap against the rim nut the four sections contract into one continuous thread. When the cap is not in use the four sections are expanded so that the diameter is larger than the diameter of the valve stem.

YOU CAN NOW TEST THE AIR PRESSURE IN YOUR TIRES WITHOUT EFFORT.

The Schrader Universal Tire Pressure Gauge has been endorsed by Tire Manufacturers as the most reliable tire pressure gauge on the market.

Price, One Dollar

For sale by Tire Manufacturers, Jobbers, Dealers, Garages, or

A. SCHRADER'S SON, Inc.,
783-791 Atlantic Ave., Brooklyn, N. Y.

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(Men Available—Con.)

0303. Managing and designing engineer of twelve years' experience in car and engine building, desires employment with automobile parts or automobile manufacturer, in the capacity of either sales promoter or production manager. Large acquaintance among dealers.

0304. Sales manager with fourteen years' experience in automobile accessory business, now employed by one of the largest manufacturers in business, is desirous of making a change for reasons which will be given in an interview and which may be confirmed by investigation. Thoroughly experienced in selling, sales systems, office management and credit work. Capable of employing and handling salesmen and getting the best results. Thorough acquaintance with big buyers. Would become financially interested in concern if services prove satisfactory. With present concern five years. Age 35 years.

0305. Superintendent of a high-grade automobile engine manufacturing company desires to make change. Good organizer, producing at low cost. Best reason for leaving present position. Best references.

0306. Mechanical and electrical engineer. Capable and energetic, with excellent executive ability. Exceptionally good practical experience on both trucks and pleasure cars; in engineering, designing, purchasing, shop practice, construction and production. Especially competent on electric systems. Able to handle men and fully capable of assuming responsibility. Married. Age 33. Salary moderate.

0307. A1 production man and engineer. Technical graduate. Four years' shop experience, one year as machinist and tool designer. Five years' engineering experience. Designer of six pleasure models and one commercial.

0308. Engineer with fourteen years' experience. Has designed and built four- and six-cylinder and Knight-engined cars, electric transmission cars and electrics, also two-speed and worm drive axles. Detroit location preferred.

0309. Technical graduate twenty-eight years of age with four years' experience in design and construction of pleasure cars, desires position as technical assistant in service department, or position leading to that of sales engineer. Now employed in engineering department of company making all its own parts.

The Automobile Club of America

54th and 55th Streets, West of Broadway, New York City

announces the enlargement of the

TESTING LABORATORY

to approximately twice its former capacity.

A new Bulletin, describing the equipment, kinds of tests, and charges for the same is ready for distribution and will be mailed to those interested upon request.

The Testing Laboratory is open to consulting engineers, manufacturers, and others for confidential development work or official tests. The reports of the latter are accepted by the profession and the public as authoritative and absolutely unbiased.

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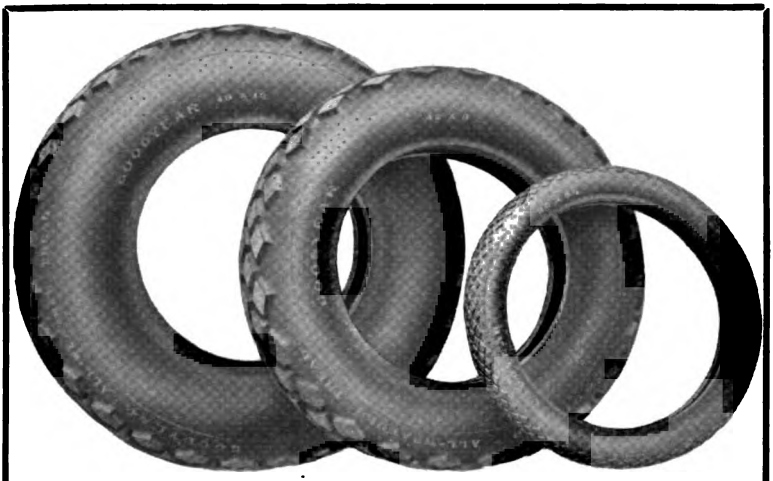

High-Speed Trucks Should Have Pneumatic Tires

Not only do such tires make possible a higher speed, but they save money in the form of reduced wear and tear on the truck and its contents.

Large size pneumatic tires for trucks are a proven and eminently practical proposition. Even at low speeds they have great advantage on rough roads, and may be used all year 'round through rain and snow. Chains necessary only on wet ice.

We can furnish pneumatic truck tires (with All-Weather Treads) in the following sizes:

38x5½ in. 39x6 in. 38x7 in.
40x8 in. 42x9 in. 48x12 in.

Proper equipment for trucks (of normal size and with proper loads):

1-ton, 5½ in. front, 6 in. rear.
1½-ton, 6 in. front, 7 in. rear.
2 and 2½-ton, 7 in. front, 8 in. rear.
3 and 3½-ton, 7 in. front, 9 in. rear.
5-ton, 9 in. front, 12 in. rear.

We are also ready to figure on pneumatic equipment for still larger trucks.

Front wheels being usually the most sensitive to shock, pneumatic tires may be used on these alone in certain instances.

We Do Not Recommend Dual Pneumatic Tires

Experiment amply shows that a single large tire per wheel is much more satisfactory, both from a standpoint of application and use. The dual tire, although theoretically good on perfectly smooth roads, continually breaks down in practice, owing to one or the other tire carrying all the load over average ruts and bumps.

You are interested in keeping down truck repair bills. Write us. We have figures that will interest you.

GOODYEAR
AKRON, OHIO
Pneumatic Truck Tires

The Goodyear Tire & Rubber Co., Desk 106, Akron, O.

Makers of Goodyear Automobile Tires

We make Demountable, Block, Cushion, S-V and Other Types of Truck Tires

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Members are requested to advise the S. A. E. office promptly of change of address, using form herewith:

SECRETARY,
SOCIETY OF AUTOMOBILE ENGINEERS,
1790 Broadway, New York City.

Please change my address now appearing on your records, to the following:

Company connected with.....

Profession or Position.....

Address of Company.....

Address for Mail.....

Articles Manufactured.....

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Very truly yours,

.....

S. A. E. Member.

"The part that sells the car"
(and truck)

Because it is known by car and truck builders and users that the science, art and practice of motor building offers nothing good that Buda fails to take advantage of.

THE BUDA COMPANY
Factory, Harvey, Ill. (Chicago Suburb)

Address FACTORY REPRESENTATIVES: BRANDENBURG & COMPANY
1108 S. Michigan Ave., Chicago
57th & Broadway, New York, N. Y. Dime Bank Building, Detroit

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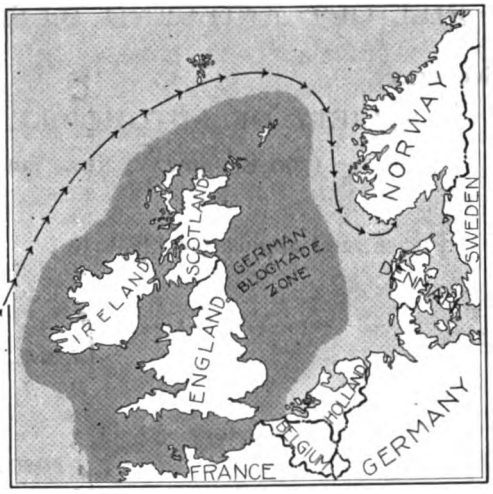
SKF

Self Aligning Ball Bearings come from Here

Deliveries are Normal



SKF BALL BEARING CO.

50 Church Street **New York City**

Special Sheet Packing for Oil, Grease, Gasoline, Water

Endura is oil-proof, grease-proof, gasoline-proof, hot and cold water-proof! *Not* dry heat-proof or steam-proof! Endura makes car joints absolutely dependable. That's its purpose!

Endura Mfg. Co.
6313 Eastwick Ave.
Philadelphia

ENDURA
Special-Purpose Sheet Packing

AMERICAN TOP COMPANY

JACKSON, MICHIGAN

Largest Manufacturer of Automobile Tops in the United States.

Quantity Production means Up-to-date Equipment, Prompt Delivery and Low Prices.

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1790 BROADWAY, NEW YORK CITY.

Please send application blank to

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POSITION AND COMPANY

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ADDRESS

whom I consider eligible to S.A.E. membership.

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S. A. E. MEMBER

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A Great Machine Shop

FERRO

This new and up-to-date machine for broaching oil holes in piston ring grooves now saves us 250% of the ordinary cost of this operation. An equal percentage is saved on many of the other 600 machines found in our shop. It will pay you to visit the Ferro and investigate the low cost of our accurate machining. Make us responsible from blue print to finished product—you will profit by our facilities.

THE FERRO MACHINE & FOUNDRY CO
CLEVELAND, OHIO

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"NORMA"
BALL BEARINGS

As an engineer you must be fully convinced of the superiority of "NORMA" Bearings for your particular purpose, before we will accept your order. We want your business—but not if your conditions will not be better met by "NORMA" Bearings than by any others—of which you must be the judge.

THE NORMA COMPANY OF AMERICA

1790 BROADWAY NEW YORK

STAMPINGS
FOR AUTOMOBILE PARTS

Let us estimate on Hoods, Clutch Cases, Covers, Joint Cases, Housings, Pans, Gasoline Tanks, Mufflers, Shells, Drums, Metal Instrument Boards, etc.

And, you are undoubtedly casting some parts that could be turned out better and at a lower cost by stamping.

Our facilities enable us to meet the most difficult situation in light and heavy sheet metal stamping or drawing.

It will cost you less to use our service than to maintain your own sheet metal department.

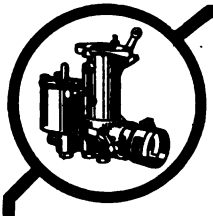
A 15 acre plant and 34 years' experience, at your service.

G.P.&F. Service

Get our prices on porcelain enameling

GEUDER, PAESCHKE & FREY CO

1365-1700 St. Paul Ave., Milwaukee, Wis



HAVE YOU READ

the new story on carburetion and Zenith principles entitled "The Compound Nozzle Explained"? It is of interest to every engineer in the motor field. There is a copy for you.

ZENITH CARBURETOR CO.

DETROIT, U. S. A.

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S. A. E. MEMBER

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ADDRESS

Date.....

DROP FORGED I BEAM FOR TORBENSEN ONE TON AXLE

WEIGHT 70 LBS.

Compare this Load Carrying Member of the

TORBENSEN INTERNAL GEAR DRIVE AXLE

with the Steel Castings used by other Systems of Final Drive. You will find a difference in our favor of over 300 pounds—nearly 20% of the Pay Load. Our design has many other equally valuable features.

TORBENSEN GEAR & AXLE CO.

224 High Street NEWARK, N. J.

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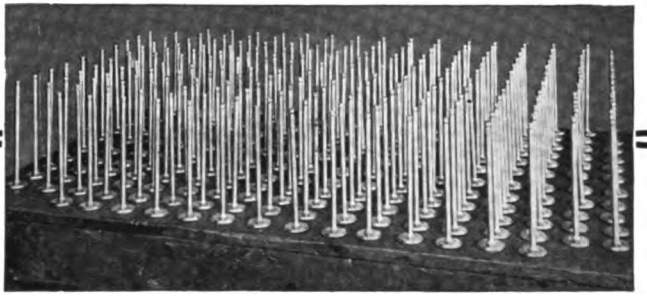
—A Valve Department

On all valve questions we invite the engineer to consult us as freely as he would any department in his own plant.

Our experience and facilities should enable us to be of assistance. In any event we are willing to try.

The Electric Welding Products Co.

"A Valve Department for Engine Makers" CLEVELAND, O.



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REG U S PAT OFF

RAYNTITE TOPS

GUARANTEED ONE YEAR

(We Really Mean This)

Single and Double Texture. By actual test no advertised top material is better. Washable, grease-proof, and not affected by heat or cold. Samples FREE.

DU PONT FABRIKOID COMPANY

WILMINGTON, DEL. **TORONTO, ONT.**

A new booklet; pocket size; informative; shows how, when and where to use

DIXON'S GRAPHITE AUTOMOBILE LUBRICANTS

Sixteen pages and cover; fully and practically illustrated; sent free upon request. Mention No. 95-G.

Made in JERSEY CITY, N. J., by the

JOSEPH DIXON CRUCIBLE COMPANY

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Please send application blank to

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NAME

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whom I consider eligible to S.A.E membership.

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S. A. E. MEMBER

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Date.....

The Best Motor for Power
Has Valves in the Head

The Best Valve in the Head Motor is the *STERLING*

STERLING MOTOR COMPANY
1145 West Grand Boulevard **Detroit, Michigan**

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Type "D"

Chrome Vanadium Spring Steel

For springs that give satisfaction in the wear and tear of actual every day service—that take the bumps and save your engine —use Chrome Vanadium Steel

Endurance ***Life*** ***Resiliency***

Canton

Chicago **New York** **Detroit**

D. W. F. STEEL BALLS

THE IDEAL TRANSMISSION

RENOLD DRIVING CHAINS

"The Chains of Proven Reliability"

SHELBY SEAMLESS TUBES

Known the world over for their high degree of quality, precision and perfection of design. Made by the largest and oldest chain makers in the world.
Particulars of commercial vehicles, motorcycles and engineering sizes sent on request.

SOLE AMERICAN AGENTS

SUPERIOR AUTOMOBILE STEELS

PETER A. FRASSE & CO., Inc.

417-421 Canal Street, New York

TOOLS AND SUPPLIES

LETTERS FROM WISE ENGINEERS TO THEIR FRIENDS. No. 2

Toledo, Ohio, November 9, 1914.

Emil Grossman Manufacturing Company, Inc.
Bush Terminal, Model Factory No. 20,
Brooklyn, New York City

Dear Mr. Grossman: Confirming conversation with you at Chicago recently, I am pleased to state that I am now using my third Reo automobile equipped with your Red Head Spark Plugs. I have averaged better than 6,000 miles per year on each of my cars, and it has been gratifying indeed that I have not had occasion to change a spark plug in either of the three cars, which, I think, speaks well for the efficiency of your plug. Yours truly,

[Signed] A. B. COFFMAN.

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SNOW—
Up to the Hubs

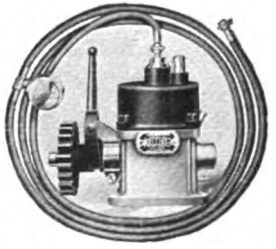
Picture yourself in such a position! Aside from the motor, the transmission and rear axles are the parts on which you *depend* for freedom from being "stuck." American Die & Tool Company's

TRANSMISSIONS
REAR AXLES

are built to give prime service under unusual conditions like this. They embody the best points of *all* rear axles—designed only to give maximum *service* economically under any conditions.

Many designs on hand for all sorts of motors and chassis—or special designs from your own ideas. We'll gladly consult with you.

AMERICAN
DIE & TOOL COMPANY
READING, PA.



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Manufacturers of Automobile Wheels
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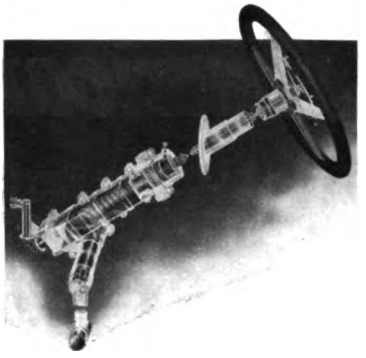

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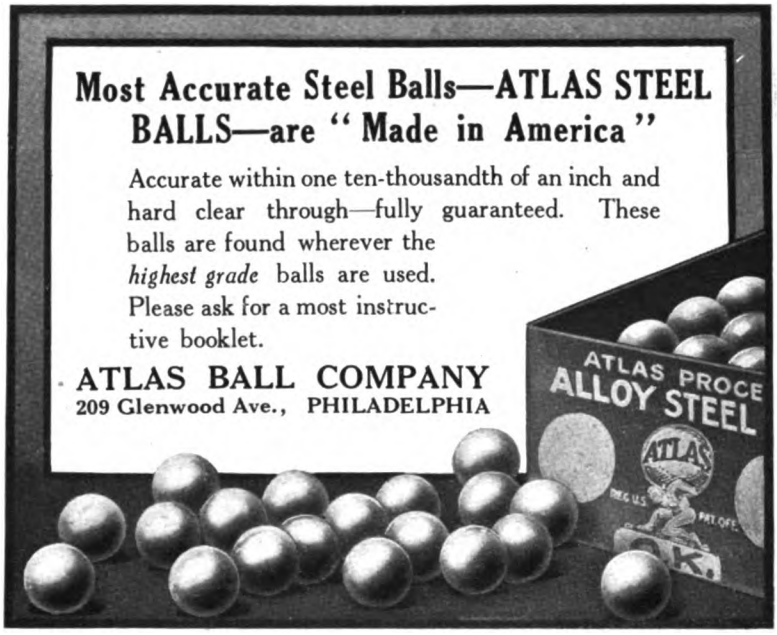

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This experience is at the service of automobile builders. Westinghouse Engineers co-operated in the equipment of the cars listed below with Westinghouse Electric Systems

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Auburn	Glide	Moreland	Seagrave
Austin	Halladay	National	Singer
Briggs-Detroiter	Hupmobile	Norwalk	Speedwell
Case	Kissel	Ohio	Standard
Chadwick	Kline	Pathfinder	Stewart
	Lauth-Juergens		Vulcan
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Westinghouse Electric & Mfg. Co.

Automobile Equipment Dept.

Pittsburgh, Pennsylvania

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AND MANY OTHER CARS.

COMPETENT ADVICE ON PROPER TYPE, SIZE AND APPLICATION OF ELECTRIC STARTERS.

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TRANSMISSION
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Unit Power Plant Transmissions to fit all standard motors up to 40 h. p.

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A considerable portion of your efforts in the S. A. E. have been devoted to securing uniformity of the various parts that enter into the construction of your car or motor.

Therefore, we believe that you will appreciate this feature in a product which enters not only into the operation of your car, but has a direct bearing on the upkeep—the motor oil.

In the manufacture of

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our Refining Department spares no pains to make each shipment of oil conform to a set standard of quality. Examine two lots of Texaco Motor Oil, produced and sold at different times in the year, and you will find them identical in all characteristics, as well as in the high efficiency of lubricating service, and freedom from hard carbon in use.

The care taken in refining is reflected in the benefits the car owner derives in operation.

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First: How well suited it is to the engine it is to start.

Second: How well made it is.

The latter depends upon who made it.

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The Starter that is built to order

is made by the third largest of the great electrical machinery manufacturers of America.

For 24 years the Wagner engineers have specialized in the development of motors, generators, transformers, converters, rectifiers and electrical instruments of precision.

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for Automobile Engines

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We can design for your car a silent chain system which will be satisfactory in every respect.

We will not qualify that statement. We mean "satisfactory in every respect" because we know what our chains, the best in the world, are doing on other cars, and will surely do on yours.

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Accuracy—

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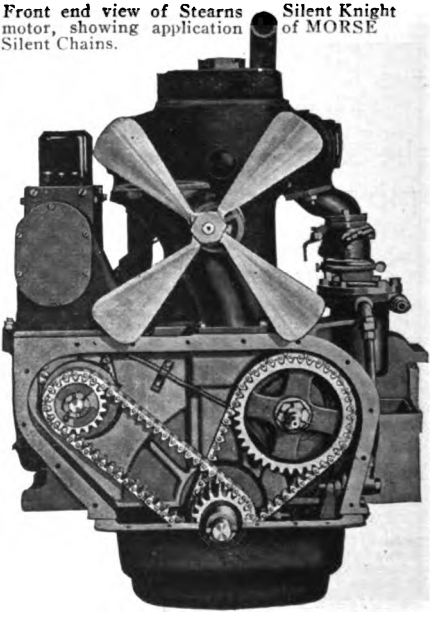
Links made of special alloy steel, heat treated.
Pins made of 4% nickel steel, case hardened.

Guarantee—

All chains guaranteed against defective materials and workmanship for one year.

Front end view of Stearns Silent Knight motor, showing application of MORSE Silent Chains.



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Largest exclusive manufacturers of silent-chain transmission in the world

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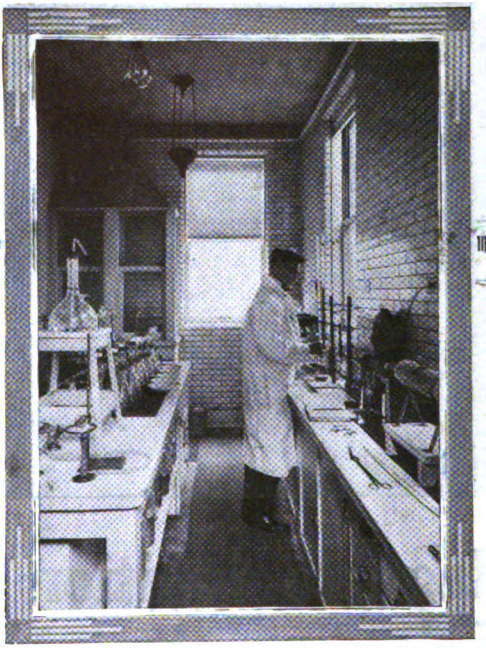

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Cleveland, Ohio

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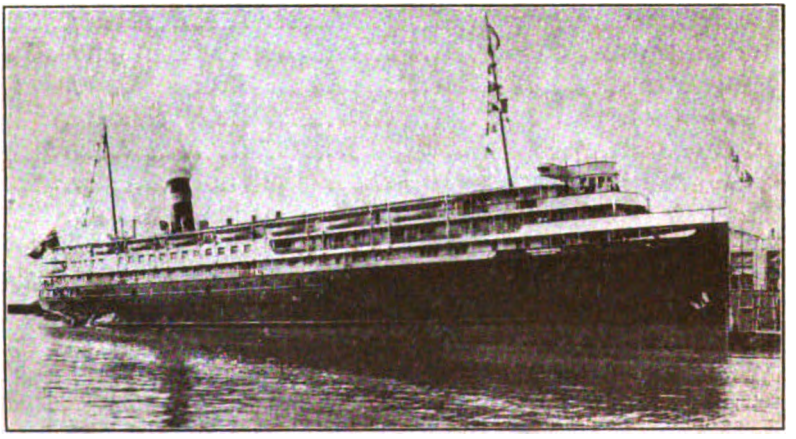
VOL. VII NO. 6

SAE BULLETIN

MAR. 1915

SUMMER MEETING CRUISE



S.S. NORONIC

LEAVES DETROIT JUNE 14

SOCIETY OF AUTOMOBILE ENGINEERS
1790 BROADWAY · NEW YORK

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SAE BULLETIN

VOL. VII MARCH, 1915 NO. 6

Published by the Society of Automobile Engineers
1790 Broadway, New York

WILLIAM H. VAN DERVOORT, President. COKER F. CLARKSON, Secretary.
ARTHUR B. CUMNER, Treasurer.

Issued monthly, 50 cents a number, $5.00 a year; to members 25 cents a number, $2.50 a year. Entered as second-class matter, August 27, 1914, at the post office at New York, New York, under the Act of August 24, 1912.

STANDARDS COMMITTEE MEETING
DETROIT, APRIL 22

The Spring Meeting of the Standards Committee will be held at its newly established office in the Boyer Building, Detroit, on Thursday, April 22nd, at ten o'clock A. M. Meetings of some of the Divisions will be held in Detroit on the same day and a few days prior thereto. The purpose of the Standards Committee meeting, which will extend throughout the day, is to receive interim reports from its Divisions or sub-committees and to take up any new business that may properly come before it. Meetings of the Springs Division and of the Miscellaneous Division have been held this month with a view to submitting next month to the Standards Committee reports as to the progress made in the work they have in hand. It is expected that the Carburetor Fittings Division, the Electric Vehicle Division, the Iron and Steel Division and the Research Division will also make reports.

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New regulations governing the procedure of the Standards Committee and the formulation of reports recommending mechanical standards and practices have been approved by the Council. These regulations are printed elsewhere in this BULLETIN. The members will be interested to scan the provisions as to the appointment, organization, functions and procedure of the committee. The purpose is to make the proceedings and reports somewhat more formal, as will be understood readily from reading the new rules. It is believed that the standardization work, which is now in its second stage, so to speak, can henceforth be conducted and promulgated in a more thorough manner. Chairman Zimmerschied is devoting considerable time to the matters under advisement by the Divisions and will be assisted by A. C. Woodbury, who has been appointed Recorder of the Standards Committee.

Among the subjects which will probably be discussed at the April meeting are:

Curves and tables of physical properties of S. A. E. alloy steels.
Uniform license pads and mounting of same.
Speedometer-drive shaft-ends.
Exhaust manifold outlet for hot-air carbureter connection.
Dimensions of piston ring grooves.
Distance between cylinder boss and center of side-outlet carbureter.
Speed and mileage rating of electric vehicles.
Motor voltage of electric vehicles.
Efficiency test of solid tires.
Number of cells in standard battery vehicle equipment.
Flat fan belt widths.
Rubber hose and hose clamps for cooling systems.
Cotter pin sizes.
Nomenclature of cantilever springs.
Test of parallelism of eyes and master leaf of leaf springs.
Modification of eye and bolt tolerance for leaf springs.
Frame brackets for leaf springs.
Offset of center bolts of leaf springs.
Nuts for spring clips of leaf springs.
Modification of center bolt standard for leaf springs.
Width of springs for pleasure and commercial cars.
Center bolt nuts of leaf springs.
Length, opening, etc., of spring clips of leaf springs.
Spacing of clips.
Pressure blocks.

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Length of spring seat.
Material between spring and spring seat.
Concavity of leaf spring material.
Standard inspection methods and physical tests of leaf springs.
Standard tolerances as to height and load of completed spring.

All members of the Society are welcome at the Standards Committee meeting.

SUMMER MEETING

DETROIT-GEORGIAN BAY AND RETURN

June 14-17

SCHEDULE

Leave Detroit, Monday, June 14th, 2:00 P. M., Central Time, *S. S. Noronic.*

Arrive Midland, Tuesday, June 15th, 2:00 P. M., Eastern Time, *S. S. Noronic.*

Leave Midland, Tuesday, June 15th, 2:15 P. M., Eastern Time, *S. S. Waubic.*

Arrive Parry Sound, Tuesday, June 15th, 6:00 P. M., Eastern Time, *S. S. Waubic.*

Leave Parry Sound, Wednesday, June 16th, 9:00 A. M., Eastern Time, *S. S. Waubic.*

Arrive Point au Baril, Wednesday, June 16th, noon, Eastern Time, *S. S. Waubic.*

Leave Point au Baril, Wednesday, June 16th, 3:00 P. M., Eastern Time, *S. S. Waubic.*

Arrive Parry Sound, Wednesday, June 16th, 6:00 P. M., Eastern Time, *S. S. Waubic.*

Leave Parry Sound, Wednesday, June 16th, 6:15 P. M., Eastern Time, *S. S. Noronic.*

Arrive Detroit, Thursday, June 17th, 5:00 P. M. Central Time, *S. S. Noronic.*

Members going East can leave Detroit at 6:10 P. M.

Luncheon will be served on board the *Noronic* before arrival at Midland on the 15th. It is necessary to board a smaller steamer to make the trip through the far-famed Thirty Thousand Islands, and for this purpose S.S. *Waubic,* in addition to the *Noronic,* has been chartered. The entire passage through the islands to Parry Sound will be made in daylight. The scenic features of the trip are undoubtedly most attractive.

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The *Noronic*, on which dinner will be had on Tuesday evening, the 15th, will remain at Parry Sound over night. The following morning the members will again embark on the *Waubic*, for Point au Baril, a charming summer resort where a picnic lunch will be served on shore.

The committee feel that this year's Summer meeting will be the best the Society has ever had, it being held during a delightful cruise on the fresh-water seas to a unique region beyond the boundary of the States, with pleasant changes from life on the big boat to visits ashore and day excursions on the *Waubic*. There will be plenty of time for entertainments, in providing which the members and Sections are so characteristically capable.

President Van Dervoort has ruled that the presence of the ladies is essential to the success of the meeting; the wives and children of the members will be welcomed most heartily on the enjoyable and instructive trip. The trip will be *different*, because the Georgian Bay Country is new to most of the members.

Chairman Lloyd, of the Meetings Committee, promises a technical program of marked interest and value, the presentation by well qualified engineers of several broadly important subjects, as well as various Standards Committee reports, being provided for.

These matters will be presented at professional sessions arranged as follows:

Monday afternoon.....*Standards Committee Meeting*
Monday evening.....*Business and Professional Session*
Tuesday morning.....*Professional Session*
Tuesday evening.....*Professional Session*
Wednesday evening.....*Professional Session*
Thursday morning.....*Professional Session*

EXPENSE OF THE TRIP

The fare for the complete trip on the *Noronic* and the *Waubic* is $26 per person, berth and meals included. The *Noronic*, which will be the home of the members on the trip, will accommodate six hundred passengers comfortably. The seating capacity of the dining room is unusually large, and the facilities for service therein remarkably good, fireless cookers being provided at each serving table to keep the gasoline hot. "Fine food properly cooked and properly served" is a slogan of the company, which the committee will subject to a breakdown test.

Applications for accommodations on the trip are being received at the Society office now, and assignments will be

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made in the order of receipt as soon as the bookings are entered. In the next BULLETIN full detail information as to the trip and meeting will be given. Meantime it is suggested to the members that they make early arrangements to join the charter party, which, according to every prospect, will be one of no regrets but much enjoyment and value and pleasant remembrance. There is every reason to believe the members will enter upon and participate in the voyage many strong. Five hundred and seventy-seven, aside from the ship's officers and crew, registered on the *City of Detroit III* at the time of the Society's trip aboard her in 1913. That meeting was so successful that many wise men said it could never be duplicated in professional interest and rousing fun. The committee refuses to believe this. It will gladly send upon request any further information about the coming Thirty Thousand Islands trip.

THE NEW MEMBERSHIP LIST

Early in April there will be distributed a new list of members of the Society which it is hoped will prove of value and service. An attempt was made to improve upon the form and style of the present list and to this end two classifications are made. The first is an alphabetical list of the members, proper abbreviations indicating the various grades, with the names of the companies with which they are connected and their positions therein. The second is an alphabetical list of the companies represented in the Society, with the names of all members in their employ and with a list of the articles manufactured by each company.

A further improvement is the use of a heavier and more durable paper and larger, clearer type. The lists are printed in such a style that the residence of the members and the geographical location of the companies with which they are associated can be ascertained readily by running over the lists. The new list will contain about 150 pages as compared with 70 in the present list.

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REGULATIONS GOVERNING STANDARDS COMMITTEE

I.—ORIGIN AND FUNCTIONS

1. The Standards Committee of the Society of Automobile Engineers shall have jurisdiction over the formulation of all standards, recommended practices, et cetera, which may come before the Society for final adoption. It may also be charged with such special deliberations or investigations as the Council may deem advisable or necessary for the preparation of authoritative reports. The results of these investigations may, in the discretion of the Council, be made the subject of special reports.

II.—ORGANIZATION

2. The Standards Committee shall act under the direction of a Chairman, who shall be, ex officio, a member of each Division, and who shall be assisted by a Recorder.

3. The whole Committee shall be resolved by the Council into a number of Divisions, each charged with the consideration of an appropriate group of subjects, and presided over by a Division Chairman. Any Division may be resolved further into such Sub-Divisions as the Division Chairman may deem expedient.

III.—APPOINTMENTS

4. Appointments to membership on the Standards Committee shall be made annually, by the Council in conference with the Chairman of the Standards Committee. The Chairman of the Committee and of its Divisions shall be designated annually by the President of the Society.

5. The President and Secretary of the Society shall be, ex officio, members of the Standards Committee and of its Divisions.

IV.—PROCEDURE

IN DIVISIONS

6. However initiated, proposed new standards or revisions of existing standards must issue as a report from that particular Division within whose province such matters properly belong. Whenever possible this report shall be submitted to letter ballot of all the members of the Division from which it issues. A majority of the members of a Division shall constitute a quorum. In special cases final action may be taken at a Division meeting specifically called for that purpose. A majority of those voting shall be necessary to approve a report. Each report, signed by the Division Chairman, shall carry the following statement at its conclusion:

"This report has been submitted for consideration to——members of the ——Division, which consists of——members, of whom——have voted affirmatively,——negatively, and——have refrained from voting." Dissenting members shall have the right to present minority reports individually or jointly.

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7 No action affecting the substance of reports shall be taken by any Division except at meetings called for that purpose.

8. Reports should consist generally of complete but concise statements of the practices, constructions, etc., as recommended, together with such illustrations as may be necessary. There should be appended also explanatory remarks of the recommendations made.

IN STANDARDS COMMITTEE

9. Reports of the Divisions shall be submitted to the Standards Committee for approval. Fifteen members of the Standards Committee shall constitute a quorum. After approval by the Standards Committee in original or amended form, Division reports shall be transmitted, with a record of the vote thereon, to the Council for its approval for submission to the Society. The majority of those voting in the Standards Committee shall be necessary to approve a report.

IN COUNCIL AND SOCIETY

10. After approval by the Council. each Division report approved by the Standards Committee shall be submitted for discussion to the Society at a properly constituted Annual or Semi-Annual meeting, at which it may be amended, sent back to the respective Division, or approved for submission by the Secretary to letter ballot of the Society. A majority of those voting shall be necessary to submit to letter ballot.

THE LETTER BALLOT

11. The letter ballot shall provide for the recording of affirmative and negative votes and waivers, and shall be returnable to the Secretary of the Society within sixty days following the meeting. The adoption of the report shall be decided by a majority of the letter ballots cast.

V.—MEETINGS

COMMITTEE MEETINGS

12. Regular meetings of the Standards Committee shall be held on the first day of or on the day preceding each Annual and Semi-Annual meeting of the Society; also on the second Thursday in April* and October of each year.

DIVISION MEETINGS

13. The time of the regular meetings of Divisions shall be the days of the regular Standards Committee meetings, or those immediately preceding.

Special meetings may, with the approval of the Chairman of the Standards Committee and the Secretary of the Society, be held at any appropriate time upon two weeks' notice, at the suggestion of the respective Division Chairman, or by direction of the Chairman of the Standards Committee.

SCHEDULES

14. When the Chairman of a Division desires to call a meeting, he shall notify the Chairman of Standards Committee, stating the purpose

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and his preference as to time and place. The Standards Committee Chairman shall then prepare a schedule of Division meetings with a view to avoiding conflicts and obtaining the best co-operation.

VI.—COMMITTEE RECORDS

ATTENDANCE

15. The Recorder of the Standards Committee shall keep a roll of the members of all the Divisions and shall record the names of all members in attendance at each meeting. In his absence such attendance records shall be transmitted to him by the Division Chairmen. If a member, or his authorized representative, is absent from three consecutive Division or Standards Committee meetings without previous notice to his Chairman or to the Recorder, the Recorder shall notify the member that unless he advises that he wishes to continue as a member of the Division, with the assurance that he will in the future be in a position to take an active interest in the work of the Division and attend its meetings, his name may be dropped from the roll of membership. Such notices shall be sent out by the Recorder only with the approval of the respective Division Chairman and the Council of the Society.

REPORTS

16. The Chairman of each Division shall submit to each regular meeting of the Standards Committee a report of the progress in the work assigned to that Division. Such report shall be made by the Chairman in person, and a copy filed with the Recorder; except that when the Chairman is absent from a meeting, a report of the Division shall be made by some member of the same, designated by his Chairman in writing to the Recorder, which member shall be in a position to explain all items contained in the report. Record of the failure to submit such report shall be entered in the minutes of the respective meeting.

DEPOSITORY FOR RECORDS

17. The Chairman of any Division, or some officer of the same, after completion of each subject referred to said Division, shall transmit all correspondence filed on that subject to the Secretary of the Society.

VII.—MISCELLANEOUS

PUBLICITY

18. Divisions shall have no right to issue matter for publication through other than the regular Society channels, unless so authorized, for reasons of weight, by the Council.

STATIONERY

19. Official correspondence, especially requests for information as to practice, et cetera, shall be conducted on official stationery which will be furnished by the Secretary of the Society.

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EXPENDITURES

20. No obligation for expenditures other than postage will be assumed by the Society unless such expenditures have been incurred in pursuance of previous authorization by the Council, and then only within specific fixed amounts. The solicitation of funds for research or other legitimate expenditures may be made by Divisions on their own behalf or on the behalf of the Society, only with the express sanction of the Council. All funds thus collected shall be transmitted to the Secretary of the Society, who shall deposit and place the same to the credit of the respective Divisions on the books of the Society, subject to disbursement only on vouchers signed by the Chairman of the respective Division concerned.

CORNELL STUDENT BRANCH

The Constitution of the Society as amended last August provides for enrollment individually or by group of persons under thirty years of age who, at the time of application, are bona fide students of recognized institutions of engineering or pursuing a course of study in automobile engineering. Student enrollment in the Society is limited to a term of three years which is not renewable. The enrolled students are not entitled to vote or hold office in the Society and are not members of the same in any sense.

A number of students taking courses at different colleges have taken advantage of the authorization of the above mentioned enrollment, and pursuant to the recent amendment made to the By-Laws, the Cornell Student Branch of the S. A. E. has been organized. The amendment to the By-Laws which was made in this connection by the Council at its last meeting is to the following effect:

ADDITION TO PARAGRAPH 5 OF THE BY-LAWS

> "The Council may in its discretion authorize the organization of enrolled students of the Society as student branches at recognized institutions of engineering, for purposes which are in harmony with the object of the Society; such student branches to have such powers and to act under such regulations as the Council may from time to time prescribe."

Rules governing the organization of student branches have been approved by the Council. Any Member of the Society connected with a university or technical school of recognized standing may, upon the approval of the Council, organize the enrolled students of the Society in that institution as a Student Branch. At the meetings held by a Student Branch the papers read and discussed may be either original papers or papers read before one of the regular meetings of the Society or any of its Sections.

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At the first meeting of the Cornell Student Branch, about sixty-five were present, over forty applying for membership in the Branch. It is stated that the membership will probably soon be more than one hundred. The following officers have been elected:

Honorary Chairman.....PROFESSOR R. C. CARPENTER
Branch President.....LENOX R. LOHR
Branch Vice-president.....P. K. LINSEY
Branch Secretary.....H. A. KNIGHT
Branch Recording Secretary.....N. W. SUITER
Branch Treasurer.....S. DEWSNAP

At the first meeting of the Branch Professor Carpenter gave a brief history of the S. A. E. and described the evolution and progress of the motor car. At a subsequent meeting Professor C. A. Pierce gave an address on the fundamentals of the automobile.

Presented at Metropolitan Section Meeting.

THE HIGH-SPEED, HIGH-EFFICIENCY EIGHT-CYLINDER V-TYPE ENGINE

BY D. MCCALL WHITE.

(Member of the Society.)

There is probably no subject which is commanding so much the thoughts and attention of motor car engineers today as the high-speed high-efficiency eight-cylinder V-type engine.

As soon as the world began to take cognizance of the new method of locomotion, it also began to demand more and greater achievements. It demanded greater efficiency, flexibility, comforts, conveniences and luxuries. It demanded in greater measure those things which heighten the enjoyment and add to the pleasure of motoring. It is demanding with equal insistence the elimination of those things which have a tendency to detract from motoring pleasure and enjoyment.

Serious minded motor car manufacturers have vied with each other in efforts to meet the motorists' ideals. You all know of the evolution. From the single-cylinder to the two-, from the two- to the four-, from the four- to the six- and lastly from the six- to the eight- which some engineers believe marks the last word in motor car progress in the matter of motive power.

The mere matter of number of cylinders is not, however, of primary

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importance. The matter of primary importance is the number of cylinders necessary to produce a car which will perform as its user wants it to perform. After analyzing the subject and discovering what the user expects of his car, the next thing is to supply the requirements in the most practical and best balanced way. Of course, different motorists have different ideals.

For the man who simply wants a car as a means of locomotion, something that will carry him from one place to another, almost any car of today will serve the purpose. But the man who wants a car that will provide transportation with the greatest possible pleasure and comfort, both mental and physical, must look far beyond that type of vehicle which provides little or nothing beyond a means of locomotion.

The multiplication of cylinders from time to time has not been merely for the sake of obtaining increased power, but rather to obtain a steadier or more even generation and application of power to the propulsion of the car. The more evenly the power is applied to the driving of the car, the greater is the comfort experienced by the motorist, and the greater the flexibility for a given development of power.

It is not my purpose to disparage other types of motors or other methods of construction, but it would be difficult, if not impossible, for me to make clear the advantages of the V-type eight-cylinder motor without drawing some comparisons. In designing any type of motor it is necessary to keep in mind a number of primary requisites. Among these may be mentioned: size, proportion, cooling, carburetion, lubrication, accessibility, simplicity, durability and manufacturing possibilities. In the matter of size, I would say that the Cadillac eight is enclosed in practically the same hood space as was the four-cylinder engine. The length is no greater but there is about two inches greater width, the latter so small a factor as not to be worthy of consideration. When you consider that the eight delivers a maximum of 70 horsepower against about 50 for the four-cylinder engine, the advantages of the eight in this respect are too apparent to require further comment. If we were to attempt to obtain the same power efficiency from a six-cylinder engine, we would require a space approximately 50 per cent. longer for engine installation. One advantage of the compactness of the eight is that it leaves more room for body purposes on a chassis of a given wheelbase.

In the matter of weight the argument is all on the side of the eight. The weight of the present Cadillac engine is some 50 to 60 pounds less than that of the previous four-cylinder engine.

Another advantage of the V-type eight from a mechanical standpoint is that it permits the use of a short sturdy crankshaft having only four throws. With the short crankshaft the periodic vibration or thrashing which has proven so disastrous in engines where a long crankshaft has necessarily been employed is eliminated. The use of a short camshaft is also permitted. In the V-type eight there are all the advantages which accrue from the compactness of the four-cylinder engine.

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COOLING

In the matter of cooling the V-type eight lends itself very readily to efficiency. In high-speed engines particularly the matter of sufficient heating ability is as important as cooling ability. In the Cadillac eight each block of cylinders is treated as a separate unit, although one radiator is common to both. In cooling, therefore, we have the advantages afforded by four-cylinder construction and avoid the disadvantages which doubtless you all know characterize the six. In the V-type eight the amount of surface to be cooled in each cylinder block is so small relatively that the variation in the temperatures of the forward and rear cylinders needs scarcely to be taken into account. The temperature of the cooling water is controlled by a thermostatic arrangement similar to that employed in an aneroid barometer. A thermostat, consisting of a series of corrugations in a copper tube filled with diluted ether, these corrugations being at right angles to the axis of the tube, is fitted inside the suction pipe of the water pump. This thermostat by reason of expansion and contraction under the influence of the temperature of the water controls a valve which in turn opens or shuts off the water supply to the circulating pump, with the exception of a small amount to the carbureter hot-water jacket, which is fed from the hottest part of the cylinder water-jacket. When the water is cold, the pump merely circulates a small amount of water through the carbureter water-jacket from the cylinders until the water reaches the desired temperature through contact with the cylinder walls. The thermostat then expands and by so doing opens the inlet valve to the water pump, thus allowing circulation through the cylinders and radiator to take place until the temperature falls to the desired amount when the thermostat contracts, and partly or fully closes the water inlet, as the case may be, thus maintaining a practically constant temperature of the cooling water, increasing not only the efficiency of the motor but eliminating any carburetion troubles due to uneven temperatures. Carburetion, as you know, has always been recognized as an aggravating factor in multi-cylindered engines, particularly sixes. This has been due to the extreme difficulty or, I may say, impossibility of devising means for supplying the cylinders uniformly with gas, as well as lack of evenness in cylinder temperature. In the V-type eight there is no difficulty in obtaining practically uniform cylinder temperature and the construction adapts itself admirably to uniform gas distribution. We require only one carbureter, with only one float-chamber and one spray-nozzle. The carbureter is situated above the engine, between the two blocks of cylinders, midway fore-and-aft and transversely. The piping arrangement is such that there is no tendency for the gas to be drawn to one cylinder block more than to the other; and after it has been drawn to one cylinder block, there is no tendency toward its being drawn into any one cylinder rather than another. Maintenance of uniform cylinder temperature and distribution of gas is a very important factor in attaining evenness of torque.

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LUBRICATION

As regards lubrication, I think it is obvious that forced lubrication at fairly high pressure is necessary for crankshaft and connecting-rod bearings, in order to insure long life. The average life of such bearings so lubricated will almost equal the life of the engine; in any case an average of three years' wear, or approximately 30,000 miles, can be had without any replacement being necessary. So much is this appreciated in Europe that many of the well-known manufacturers provide no adjustment whatever on the main bearings, and others locate the lower half of the main bearing directly in the oil base. The methods of lubrication used on the Cadillac eight-cylinder engine are such as to insure high forced oil feed to all the bearings running at high circumferential velocities and subjected to high pressures. An oil pump consisting of two gear wheels is situated at the lowest point on the front cover of the engine, being extremely accessible for examination. This pump is driven at half engine-speed and draws the oil through a pipe of ample area, from the oil base, discharging it into a header or large reservoir pipe which extends the whole length of the crankcase, oil feeds being taken from this header to each of the main bearings, which in turn feed oil through the hollow crankshaft to the crankpins and the connecting-rod lower bearings. The wrist-pins, cylinder walls, and camshaft rockers are lubricated by the residue oil which is constantly coming out from the ends of the bearings. The other end of the reservoir above mentioned is connected to a spring-loaded relief valve (situated at the rear end of the engine) to prevent excessive pressures. The discharge of surplus oil is conducted to the camshaft bearings and finally runs on to the front silent chains and the spiral gears, for driving the oil and water pumps; returning to the base through a large gauze filter. The pipe system is tapped before reaching the relief valve, and a lead is taken to the dashboard for registering the oil pressure.

ACCESSIBILITY

To obtain access to the carbureter, electric generator, automatic cranking device, ignition current distributor and power tire pump, you have but to raise the hood and these members are conveniently before you. Access to the valve tappets is obtained by removing cover plates. Access to the crankshaft is obtained by removing the oil-pan of the engine. We have provided a feature which we believe will be welcomed enthusiastically. Above each piston an opening through the cylinder heads is provided. By removing the caps it is possible to remove carbon deposits from the piston heads and combustion chambers without the necessity of taking down the engine.

SIMPLICITY

In the matter of simplicity versus complications, it is hardly fair to compare the V-type eight with a four-cylinder engine, but even in such a comparison the eight would not be at a material disadvantage. Inasmuch, however, as on the subjects of power, torque, flexibility and general roadibility the usual comparisons are of the six and the eight, it is only reasonable that these two types be taken as a basis for comparison in this

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connection. In the V-type eight we have eight cylinders, pistons and connecting-rods, as against six in the six. There are sixteen valves as against twelve. In the Cadillac eight there are but three main bearings. In a six at least that number is demanded, and certainly more to approach the same rigidity. There are only four connecting-rod bearings, while in the six there must be six. The camshaft has eight cams; the six requires twelve. It would appear that the eight offers fully as much in absence of complication as the six.

DURABILITY

In treating of durability we must take several points into consideration. We could not reasonably compare a poorly designed and made eight with a well designed and made six. I do not hesitate to say that taking a well designed and a properly made eight as against an equally well designed and made six, the eight will be doing business long after the six has ceased performing. Vibration more than any other one thing shortens the life of a motor. In the V-type eight, properly designed and manufactured, vibration is reduced to an almost negligible factor; and to the extent that that vibration is reduced, to the same extent is longevity increased.

I might say with reference to the effect of vibration on the life of the motor, that when racing with six-cylinder engines, of which I have done considerable myself, we used to find it necessary to run the car either below or above the particular speed at which the periodic vibrations of the crankshaft were greatest, because the motor absolutely gave up the ghost in continuous performance on the racing track. We either had to reach the maximum power below that periodic vibration speed or above it.

MANUFACTURE

As a manufacturing proposition the eight presents some interesting aspects. There are so many factors which have a bearing on the subject that it is difficult to arrive at a conclusion in making comparison of the six and eight. To make such a comparison, all other things would have to be equal. We would have to assume that both were made by the same concern, or at least by concerns with exactly equal manufacturing capabilities, the same advantages in equipment, facilities and methods. In the eight there are some members which are much simpler and less expensive to produce than the corresponding parts of a six; such as crankshaft, camshaft, fewer bearings, etc. On the other hand, there are in the eight more cylinders, pistons and valves to grind.

In addition, we find that in numerous instances it is desirable to work to closer limits of accuracy. Summing up, I would say that on a basis of equally good workmanship in each case, the eight will be found to be a somewhat more expensive manufacturing proposition than a six. This does not, however, take into account the initial expense incurred in new machinery, jigs, fixtures, tools and production equipment.

It has been stated elsewhere that a certain V-type eight-cylinder engine is much heavier per unit of piston displacement than a six-cylinder engine. The eight-cylinder engine in question would not be considered

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light per unit of piston displacement and is of the slow-speed type. While its behavior is excellent, it cannot be compared with the high-speed high-efficiency eight any more than can the slow-speed four be compared with the high-speed four.

The eight-cylinder Cadillac engine has magnificent torque at low speeds, combined with the snappy acceleration and sweetness of the high-speed engine, giving a most desirable combination. This eight-cylinder engine, designed for high efficiency, gives one more the impression of an electric motor than a gasoline motor, so smooth and quiet is it in action and so even is its torque.

L-HEAD VALVES

Perhaps a few remarks would be of interest on the matter of general design. While it is admitted that with careful design a certain amount of extra efficiency can be obtained with overhead valves, I have been able over certain dimensions to hold my own with the conventional L-head type of motor. On engines of normal bore and above, this conventional type of valve-gear is, from a manufacturing point of view, easy to keep quiet and also provides sufficient power for all practical purposes. This has been demonstrated in the Cadillac engine having an A. L. A. M. rating of 31.25 horsepower and developing in excess of seventy horsepower at 2400 r.p.m. Greater power has been shown and it is possible to straighten the curve so that the line would be continuous from 1600 r.p.m., at which speed the engine develops 52 horsepower, up to 2800 or 3000 r.p.m. Further proofs of this latter point, on valve design, are the magnificent performances on Brooklands Track in England of the four-cylinder "Talbot" and others which made world records for their capacity with an ordinary standard L-head motor. Existing types of overhead valve design, while good for racing engines, are likely to introduce increased cost of manufacture, and to create undue noise, factors to be reckoned with in motor designing. In addition, although it may be urged that when the L-head type is carried into the V-engine, accessibility suffers, it must be borne in mind that all design is a compromise and that we have today such materials in the shape of special alloy steels that adjustment and valve-grinding are practically "by-words" and need be resorted to only after long periods, the operations, even then, being simple.

Again, when overhead valves of existing design are used with the V-type eight, the length of stroke must of necessity be curtailed owing to the fact that each unit block of cylinders must be at least three inches longer in the direction of the stroke and could not be accommodated inside of the engine bonnet. In order therefore to maintain what I consider a proper stroke-bore ratio, the L-head shows to best advantage.

Inclined valves are difficult to operate on account of the height at which the camshaft must be placed, of necessity above the tappet rollers owing to the fact that there must be one hundred and thirty-five degrees from the camshaft center, passing through the center of the rollers on each side, in order to give satisfactory results as regards order of firing. An explanation of this order of firing would perhaps be of interest. The firing alternates from one side to the other, so that there

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is a power impulse from a cylinder on one side followed by an impulse from the cylinder diagonally opposite on the other side.

FIRING ORDER

That is to say, assuming that one is sitting in the driver's seat, and No. 1 cylinders are at the radiator end of the engine, then we have No. 1 left-hand and No. 1 right-hand, and so forth. When No. 1 on the left-hand fires, assuming the piston to be on top dead center, then No. 1 on the righthand is half way on suction stroke.

The next cylinder to fire is No. 2 on the right-hand; No. 2 on the left-hand is then half way up on the exhaust stroke.

Then No. 3 on the left-hand fires, and No. 3 on the right-hand is half way on suction.

No. 1 right-hand fires next, and No. 1 on the left-hand is half way on exhaust stroke. The next to fire is No. 4 on the left-hand, No. 4 on the right-hand being half way on the suction stroke. No. 3 on the right-hand fires next, and No. 3 on the left-hand is half on exhaust stroke. The next to fire is No. 2 left-hand, No. 2 on the right being half on suction stroke. And finally No. 4 on the right, No. 4 on the left being half on exhaust stroke.

It is perfectly simple to follow the firing order of the eight, because all you have to do is to consider two separate four-cylinder engines, one firing 1, 3, 4, 2, and the other firing in the same order but lagging one cylinder behind, or 2, 1, 3, 4.

VALVE GEAR EFFICIENCY

In order to maintain what one might term, for want of a better name, "valve gear efficiency," it is desirable that all valve gear should be as light as possible; in fact, the reduction of weight in the valve gear should be considered of maximum importance, just as much as the reduction of weight of reciprocating masses such as the piston and connecting-rod. If one takes the trouble to run out a few figures on valve accelerations and loads in connection with the high-speed engine, it can be appreciated how necessary it is to design the valve mechanism as light as possible in conjunction with the necessary strength. For instance, if an engine, such as the one under discussion, is running at 3,000 r.p.m., a thing which can easily happen, the time taken to lift the valve is one two-hundredth part of a second and the acceleration would be 2,080 feet per second. To take care of this the valve spring must exert a load of 65 pounds. Now supposing the reciprocating masses weighed one-half pound more than the example given, then the required spring would exert a force of 97 pounds. This point is well taken care of in the eight-cylinder design, where the valve reciprocating masses are naturally less than in an engine with fewer but larger cylinders.

CAMSHAFT

In the design of the camshaft in the high-speed V-type eight, as in all high-speed engines, the greatest care must be exercised to insure that

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the camshaft is well supported on substantial bearings in order to prevent any deflection, so that there will be little noise from the valve mechanism.

The most serious defect that can be attributed to engines having long crankshafts is the disturbance or tremor which occurs at certain periods of engine speed. This periodic tremor or disturbance, no matter how small it is, or how quiet it seems, has a disturbing effect on the transmission, causing the constant mesh or neutral gears to roar or rattle Transmissions which were good, and beautifully quiet have shown this defect when fitted to six-cylinder chassis.

One of the points in connection with the eight-cylinder engine is that the bore of the cylinders being small, reciprocating masses of the lightest design can be used. I am strongly of the opinion that where high-speed engines are employed, none should be designed with four cylinders, above three and one-half inches bore. In the Cadillac engine we have the well-known eighty millimeter or 3⅛ inches bore, with which so much has been accomplished in Europe. In a four it is delightful as regards size, and when this size is designed into a V-eight, the performance surpasses all expectations in whatever direction one may examine.

The construction of the lower bearing of the connecting-rod on the Cadillac engine is interesting, in view of the fact that from opposite cylinders there are two rods on each crankpin, the forked or outer rod holding the bearing rigid, while the plain or center rod oscillates about 30 degrees on the outside of the bearing, which is of hard bronze, the actual bearing in which the crank-pin rotates being of anti-friction metal.

It is easy to obtain, without accessories in the shape of starters, etc., a proportion of eight pounds weight per horse-power developed, including flywheel, pumps, etc. I am strongly of the opinion that taking equal conditions one would have to strive very hard indeed to obtain this result with a six-cylinder engine.

As regards the carburetion in the Cadillac eight-cylinder engine, there is no necessity for a double carbureter, splendid results being obtainable from a single carbureter. It is an easy matter to roll along on high gear at 1½ to 2 miles an hour and accelerate like with an electric vehicle with perfect smoothness up to speeds considerably over sixty miles an hour with a fully loaded car.

BALANCE

We find a marked difference between theoretical balance and balance as developed in practice and application. In books and treatises on the subject the practical side of the question is frequently ignored. It should be borne in mind that all bearings have clearances and that all moving parts, whether reciprocating, rotating or oscillating, are not rigid, so that even though an engine may be perfectly balanced theoretically, it may be far from perfect when produced in practice. Every engineer who has designed engines is acquainted with this fact and painfully aware how much this point is forced upon him in multi-cylinder design where crankshafts are long and cylinder bores are large.

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I will conclude by making the statement that the Cadillac eight-cylinder engine is designed, and will be manufactured, to be more free from vibration or periodic disturbance than any other multi-cylindered engine of equal total cylinder capacity. One can stand a pencil on end on the front wings of the mudguards and run the engine at a very high number of revolutions per minute, and in addition accelerate the engine, from about one hundred revolutions per minute to very high speeds indeed, suddenly, without the pencil falling down, when the car is stationary.

DISCUSSION

R. McA. LLOYD:—I think that the piston displacement of the engine under discussion indicates that it has about four and a half cubic inches per horsepower, at 2,400 revolutions; whereas most motors I have been able to get any data on here run about seven or eight cubic inches per horsepower. It seems that Mr. White obtains a very good efficiency in each cylinder. If he had built a two- or four-cylinder motor, he would probably have produced a very much better motor than is commonly found in America.

I believe an eight-cylinder motor is smoother, easier and pleasanter to drive and has more power for its length than either the six or the four. But personally I doubt whether so much power as is provided in this case is necessary. Of course, that raises the question whether cars with such great power possibilities will be produced in large quantities, when a four-cylinder motor built just as well and with about 50 horsepower will answer the purpose. I think there is a serious question whether American builders should go to these higher-power motors in a car for the ordinary user, when it is quite possible, with proper transmission, to get along with a good deal less power. I know that it is very nice to have surplus power at times, but it certainly adds weight; a four-cylinder motor of 50 horsepower in the same space, will weigh about 25 per cent. less, if designed properly.

D. McCALL WHITE:—This particular engine is between fifty and sixty pounds lighter than the four-cylinder engine it replaced. It is 12 per cent. smaller, but develops something like 20 horsepower more.

W. R. STRICKLAND:—What test was made of gasoline economy compared with the other cars?

D. McCALL WHITE:—The eight-cylinder engine compares favorably with the four-cylinder engine of the same capacity; we have been getting 18 miles to the gallon. I have seen 22 miles to the gallon with one particular car.

SYDNEY BEVIN:—I would like to ask in what instances Mr. White finds it necessary to work to closer limits in eight- than in six-cylinder motors?

D. McCALL WHITE:—Generally speaking, we are required to work to closer limits on the bearings. On account of the way the connecting-rods are coupled up, they must be kept to much closer limits than

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in the six-cylinder motor. They are coupled up in an entirely different way than in the construction used on the four- or six-cylinder motor connecting-rod. Both rods are on one bearing; although the pressures themselves are directly on the crankpin, the center rod oscillates about thirty degrees on the outside of the bearing.

SYDNEY BEVIN:—It seems to me that the six is liable to greater periodic vibration, and that the bearings have to be fitted much more closely on the six- and the four- than on the eight-cylinder, which is not subject to such great vibration.

D. MCCALL WHITE:—I think that the expedient of keeping the main bearings tight is not the one to be adopted to avoid periodic disturbances in the crankshaft. You merely reduce the power of the motor by doing so.

L. G. NILSON:—I find that by using counter-weights on the crankshaft a great deal of the periodic vibration can be eliminated.

A. C. WOODBURY:—How is that fitting worked out on the outside of the bearing? I understand that there are no shims in the brass but that the outside of the brass must be round. After the first fitting is made the outside of the brass would be no longer round; then how is the oscillating connecting-rod fitted to the outside of the brass?

D. MCCALL WHITE:—We have a special method of fitting the brasses; we hardly scrape them in at all. They are practically mandrel fittings. Those bearings will practically never need replacing. I have seen an engine that has been taken apart after 30,000 miles, and practically no wear was apparent on either the main or connecting-rod bearings. They were put back again just as they came out.

A. C. WOODBURY:—Is the bearing area exceptionally large?

D. MCCALL WHITE:—Yes.

A. F. MASURY:—Why did Mr. White decide on making the eight with the cylinders opposite, as in the case of the De Dion, rather than set one cylinder block slightly ahead of the other, making a little longer motor?

D. MCCALL WHITE:—By offsetting the cylinders double the number of cams are required on the camshaft and the length of the crankshaft bearing is increased. The connecting-rod bearing is of considerable length. If we wanted to keep that length for each bearing, we would have a crankpin about five inches long.

A. F. MASURY:—But you have two connecting-rods on each.

D. MCCALL WHITE:—Yes, but we are using one bearing to do the whole of the work.

A. F. MASURY:—That is all right when the motor goes out of the shop and you have your factory method of making bearings and fitting them, but you have fitting trouble in the repair shop.

D. MCCALL WHITE:—This bearing may be replaced practically as cheaply as an ordinary bearing. In the offset construction a longer camshaft is necessary, which is to be avoided, especially in high-speed engines.

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A. F. MASURY:—As I remember, it adds about three and a half inches to the length all the way through.

D. MCCALL WHITE:—Yes. The length of the distance between the bearings on the crankshaft is increased as well by about two and a half inches.

F. W. SEELEY:—The provision of handholes in the cylinder heads for cleaning out the carbon is very interesting, but it subjects the motor to considerable gasket trouble. I have had experience with marine engines of the removable-cylinder-head type and never saw one that did not need new gaskets at least every three months.

D. MCCALL WHITE:—The cylinder head is designed in the ordinary way, with a screwed plug in the top, using an ordinary gasket similar to that used on the valve plugs. The one on the top of the water-jacket is simply a circular cover which is held down by means of a stud from the inner cover, threaded into the top of the cylinder. Both of these covers can be removed, when a special tool is inserted which revolves, and removes the carbon from the top of the cylinder. The valves are accessible from the valve plugs themselves.

SYDNEY BEVIN:—The lubricating problem is a very interesting one, whether it is proper to use light or heavy oil with an eight-cylinder engine. The best lubrication would be determined by the volume of oil going through the lubricating system.

D. MCCALL WHITE:—We carry about a gallon or a gallon and a half of oil in the crankcase, as with all force-feed lubricating systems, the pump itself maintaining considerable pressure on the bearings. Two types of oil are used, a thicker type in the summer time and a thinner in the winter time.

SYDNEY BEVIN:—So that you arrive at about the same viscosity?

D. M.CALL WHITE:—Yes.

SYDNEY BEVIN:—Is the endeavor to keep the water temperature practically constant by the thermostatic regulation?

D. MCCALL WHITE:—Yes.

J. E. SCHIPPER:—I would like to know if the diameter of the crankshaft is greater than that of a four-cylinder crankshaft of the same length; whether, on account of the peripheral speed of the bearings, the temperatures are higher, necessitating more lubrication.

D. MCCALL WHITE:—No, I think the diameter of the crankshaft depends on the power transmitted relative to its length, with an eight or a four. In the eight you have simply a four-cylinder crankshaft capable of transmitting the horsepower which you demand.

J. E. SCHIPPER:—The bearing temperature would correspond with that of the ordinary four-cylinder crankshaft delivering the same horsepower?

D. MCCALL WHITE:—Yes.

W. C. MARSHALL:—Seventy horsepower is not needed in a car. Running a motor which can deliver 70 horsepower, you are only getting 30 horsepower out of it most of the time, and therefore must be running it much below its maximum efficiency. In regard to

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the room taken up by the motor, why not make a V six or a V four? I designed at one time a V four and found it worked out very well; with one valve in the head and one on the side it made a very short motor. The durability of most six-cylinder engines is greater than that of the car. Why have a motor that will outlast the car fifty per cent. more than it does now?

About two years ago I made tests of a number of cars in New York City, among which was an eight-cylinder car of 50 horsepower. I did not realize at the time that that car was doing particularly well, but when I came to work up the performances of all the cars tested, using the sigma coefficient formula, I found that this eight-cylinder car performed better than any of the other cars, in four or five different cases. The cars were all tested over exactly the same routes, under the same conditions and at the same speeds. The eight-cylinder car had not been overhauled for two years. It was one of the first cars that the De Dion people put out. I cannot account for its performance, unless the sigma coefficient formula is wrong.

H. M. CRANE:—We found right away when we started figuring on a big, light engine, that the eight was much the best on the weight question, especially where no flywheel at all practically was needed, as in a boat. We superimposed the two crankpin bearings just as has been done since. This may have been done at that time in France. We used practically a marine type of box, lined with babbitt metal and fitted it to the crankpin. It was then ground on the outside and white metal fitted in the plain connecting-rod outside of that. The bearings, as they were constructed were, however, so big that we have abandoned them. They were 5½″ by 2½″ on a 7¼″ square motor.

The difficulty I see with the eight-cylinder car is more a matter of accessibility than anything else. We have so many things to attach to the motor these days that the whole length of each side of a six-cylinder motor does not provide too much room for them. In fact, when you get to reducing the size of the six you begin to look with a great deal of favor on various battery ignitions that do not take up as much room as a magneto and do not need something good and strong to drive them. Last year we managed by driving by chains to put all the accessories on one side, leaving the valves on the other, with a six-cylinder engine of 563 cubc inches displacement. The space on the side on which are the lighting generator, the water pump, the tire pump, the starting motor, the magneto and the carbureter, is pretty well filled up from one end to the other.

I find that with the prevailing grade of gasoline a great deal more difficulty is experienced with valves than ever before; principally from fouling and stems getting dirty. When taking the carbon out it generally pays to go over the valves and reset the lifters if you want to keep the engine fairly quiet.

The difficulty with the eight, from the standpoint of weight, is largely due to the fact that to get an engine nice to handle a

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reasonably heavy flywheel must be used. Mr. Masury will probably remember the effect Mr. Hewitt obtained when he used a very light flywheel; the machine was too quick on the trigger; if you accidently touched the throttle, the engine would run away. We found the same thing in the six when we went from the four. Mr. Edge was, I think, responsible for the idea that we did not need a flywheel on the six. We gradually put more weight on and the more weight we put on, the more satisfactory were the results. I think you cannot possibly use as light a flywheel on the eight as its torque characteristics would lead you to believe, and still have the car handle nicely in tight places and throttle down closely all the time when running idle.

I agree fully with Mr. White's liking for the short crankshaft, but I think, on the other hand, that in the six it is possible to make a crankshaft with practically no periodic vibration within the ordinary range of driving. The six crankshaft can easily be made large enough to completely cover that, and it is perfectly possible to use three bearings and get a satisfactory result.

I do not feel at all sure that the European trend in motor design is the right one. I do not think that the ability to get great power with small displacement is necessarily the best arrangement. The minute the effect of moving weights at high speeds is figured, it is realized that the increased power obtained is paid for heavily. That is, the power curve at best is a straight line, while the effect of the revolving and reciprocating masses, will not be a straight line but will vary as the square. The point has been reached in some of the foreign designs where the crankshaft, valves, the valve mechanism, etc., used on a 4" x 5" engine would look right over here on a 5" x 6" engine.

The public apparently like an engine that pulls heavily on the lower end of the scale, where in the case of the ordinary cars of American design the engines pull excellently, that is at between fifteen and thirty miles an hour. Whether an engine will develop 50 or 60 horsepower at the high end makes a difference of only a very few miles per hour in the aggregate. A car with 50 actual horsepower will attain a speed of 56 to 60 m.p.h. The same car equipped with a 70- or 80-horsepower motor will attain 65 or 68 m.p.h. To the average man that does not make a bit of difference. He does not want to go as fast as either of those speeds anyway. I know that to be true from experience with a car built to sell at a high price.

CHAIRMAN ANGLADA:—From your experience do you judge that gas distribution is more difficult in the eight than in the six?

H. M. CRANE:—No, the conditions are not very different. The six readily divides itself into two three-cylinder engines and the eight into two fours. I do not see why one should behave differently from the other.

I think Mr. White is entirely too pessimistic about the length of the six-cylinder engine, when he states that it is fifty per cent.

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greater than in the case of the eight. You can add to a four-cylinder engine two cylinders of the same size you have already used and still not have a fifty per cent. longer engine, because considerable space is taken up by the fan, chain drive, etc., which are very nearly the same in both cases.

As to piston displacement, I figured a four against a six, both around 300 cubic inches, and the four was only five inches shorter than the six; and the four was extremely short.

I think the eight and the six are about the same in weight. I am sure a four can be built lighter. Mr. White does not give due credit for the amount of cast iron that was used in the old Cadillac engines, in which the crankcase as well as the cylinders was cast iron. I am sure he would not hesitate to promise 70 horsepower in a four-cylinder engine of the size of the old one. I agree with him that he would not have as nice a running engine as the eight. I think it is going to be a very pretty fight, but I feel that the six has the call on cost of production. A six with the crankcase built integral with the cylinders, with the top slabbed off, the way all the motors practically are built, is a wonderful construction from the point of view of economy. It is a construction that we can hardly expect to get in the eight. It will probably always mean a difference of $50.00 or $100.00 in the selling price.

A. F. MASURY:—On the question of flywheels, we started out on the eight with practically nothing more than a fan, to pull air through the radiator. Then the fan grew smaller and the flywheel bigger until it was man size, as big as most four-cylinder flywheels, weighing somewhere around 120 pounds.

As to extra speed and how many people want it, I took a contract for a car that was to run from 4 to 70 m.p.h. on high. It seemed that we were going to have some difficulty to produce the car. I managed to reach the lower speed. The customer never wanted to go much above 68 m.p.h. Mr. Crane's point is well taken that people really do not want such great speed and power.

I want to bring up again the matter of the thermostat. What would happen in zero weather? Would not the radiator be apt to freeze if the motor became too cool and the thermostat shut down so that circulation was through the motor alone?

D. MCCALL WHITE:—It is impossible for the radiator to get as cold as that, because the temperature of the whole system is maintained very closely. The variation is probably only two or three degrees, and the thermostat acts at once.

A. J. MOULTON:—I would like to ask Mr. White what compression ratio is used in the eight.

D. MCCALL WHITE:—About five to one. It is not necessary to have high compression to get high power. It is only used to get rapid ignition at extremely high speeds.

J. R. CAUTLEY:—Is not the V type engine apt to have a good

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deal of trouble with lubrication? Of course, they all have splash lubrication, but if the lubrication of one cylinder depends on the other, does any trouble develop? Do you use baffle plates?

D. McCALL WHITE:—No baffle plates are used.

J. R. CAUTLEY:—You have had no trouble from one side to the other with lubrication?

D. McCALL WHITE:—No.

H. M. MARTIN:—I would like to ask Mr. White if the forked connecting-rods are all on one side.

D. McCALL WHITE:—Yes.

H. M. MARTIN:—In connection with periodic vibration, do you find in the six-cylinder engine only one period of vibration, or two different periods at different speeds, or perhaps more?

D. McCALL WHITE:—That depends on the speed at which the engine is designed to run. Generally, in a high-speed six, there are about three periods. The first one begins at about 800 r.p.m. and the next between 1,200 and 1,400.

H. M. MARTIN:—So that one bears a certain fixed relation to the other?

D. McCALL WHITE:—Yes.

J. E. SCHIPPER:—I would like to ask how the total weight of the reciprocating parts of an eight compares with that of a four of the same piston displacement. Can you make the reciprocating weight less per cylinder of the same size, with the V arrangement?

D. McCALL WHITE:—Considering an eight of a given capacity and designing a four of the same capacity, the total weight of the reciprocating mases of the eight would be less than those of the four, because it is possible to make the pistons on a small-bore engine very much lighter in proportion.

A. M. WOLF:—I would like to ask Mr. White in more detail about the water circulation. Is it reduced to a minimum through the radiator, so that there is always some circulation through it?

D. McCALL WHITE:—Yes, the water is drawn by the water pump from the cylinder water-jackets through the carbureter water-jacket and discharged through the radiator. When the temperature reaches a certain predetermined point, the thermostat operates and allows the pump to circulate all the water from the cylinder through the radiator. There is always a small quantity of water passing through the radiator. The water is practically throttled until the temperature reaches a certain height.

A. M. WOLF:—The intake manifold may be a perfectly straight T on a six-cylinder motor, but that might not give correct distribution. I believe that a double carbureter would be the thing for an eight. Have any tests been made, taking manograph diagrams of the pressures in the intake manifold with one cylinder block firing and the other "dead," and then with both blocks firing, to determine if one branch was robbing the other?

D. McCALL WHITE:—We find we cannot get as much power with

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two carbureters; that is to say, the engines do not seem to fire as well at high-speed as with one. There is great difficulty in building an engine that will pull at very low speed under heavy load, where two carbureters are employed, the difficulty of adjusting two throttles so that the two four-cylinder blocks will be attuned with one another being one factor.

A. M. WOLF:—Can you give any figures of the oil pressure maintained and of the flow per minute at normal speeds?

D. MCCALL WHITE:—The pressure varies with the speed of the motor until a certain point is reached, when it becomes more or less uniform.

A. M. WOLF:—Can you give a figure at, say, 1,000 or 2,000 r.p.m. or up to the speed at which the maximum pressure is developed?

D. MCCALL WHITE:—At about 1,000 r.p.m. the pressure is somewhat near 20 or 25 pounds; and at higher speeds it depends on the temperature of the atmosphere; as the air becomes cooler, the oil also becomes cooler and more solid, as it were, and therefore the pressure rises.

A. M. WOLF:—Where are the points of adjustment of the chain accessory drive?

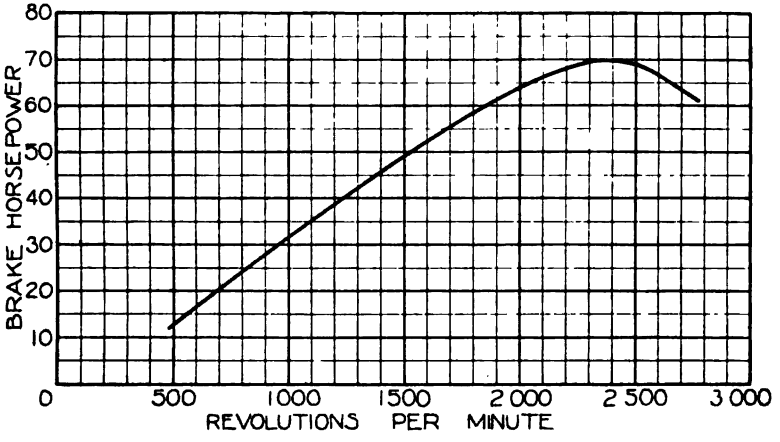
D. MCCALL WHITE:—The chains are of such size that no adjustment is necessary. They are almost big enough to drive an automobile.

A. M. WOLF:—Can you state offhand their approximate size?

D. MCCALL WHITE:—About inch and a half.

A. M. WOLF:—There is a statement in the paper that 70 horsepower is developed at 2,400 r.p.m. and 52 at 1,600. Can you tell at what r.p.m. the maximum point of the horsepower curve is reached, where the torque curve begins to drop?

D. MCCALL WHITE:—That depends on how the motor is designed.



POWER CURVE OF THE CADILLAC EIGHT-CYLINDER ENGINE.

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A motor can be designed so that the power curve will be straight up to more than 3,000 r.p.m. We do not consider it advisable to do so, because the power is sufficient for all practical purposes without doing so.

A. M. WOLF:—I am not speaking about how the motor can be designed. In the motor under discussion as turned out, what are the characteristics of the torque curve?

D. MCCALL WHITE:—The power curve itself is practically straight, so the torque curve must be more or less straight up to a point where it begins to fall off.

L. P. PROSSEN:—Mr. White stated that the pressure of the oil depends on the speed of the motor. I do not see how that that can be if a safety valve is used.

D. MCCALL WHITE:—That depends on the pressure on the safety valve and the size of the valve, as well as on the volume of oil pumped in a given time. The safety valve might be large enough to take care of a certain volume of oil up to a certain point, and when that point is reached the pressure would remain more or less constant. When the motor is running fast and the oil pressure rises, more oil leaks from the bearings, whereupon the bearings themselves act as relief valves. As the speed rises, the oil pressure is built up.

A. F. MASURY:—At low speeds a certain volume of oil must be pumped before the relief valve opens?

D. MCCALL WHITE:—Yes.

A. F. MASURY:—What do you mean by low speeds?

D. MCCALL WHITE:—600 or 700 r.p.m.

A. F. MASURY:—After that the pressure remains constant?

D. MCCALL WHITE:—Yes.

A. F. MASURY:—Under ordinary conditions you never run under 600 r.p.m.

D. MCCALL WHITE:—These motors run about 75 to 100 r.p.m. High pressures are not necessary then.

A. F. MASURY:—When the torque curve is subject to great variations is that not just the time high oil pressures should be provided? That is, at about 600 revolutions the torque may be anything.

D. MCCALL WHITE:—The torque curve is a straight line, practically, from 100 revolutions up.

A. F. MASURY:—That is not the case with an electric motor.

D. MCCALL WHITE:—The electric motor is not all that can be desired.

A. F. MASURY:—It is certainly more desirable in this respect than a gasoline motor.

H. G. MCCOMB:—An article by Mr. Heldt in the *Horseless Age* showed that the unbalanced forces in an eight-cylinder motor tend to produce transverse vibration of the frame. Mr. White might tell us something about that, if he would.

D. MCCALL WHITE:—I think I have covered that pretty thoroughly

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in the paper, where I said that while any one might write a long article on the theoretical balance of masses, the tremendous difference between theoretical balance and balance developed in practice is not generally considered. It is possible to balance an eight-cylinder motor, as I have explained, so that no vibration whatever is perceptible.

HERBERT CHASE:—Mr. White spoke of the relative power developed by the Cadillac four and the Cadillac eight. What is the difference on the basis of equal piston displacement per minute?

D. MCCALL WHITE:—If I remember correctly the Cadillac four is some twelve per cent. larger in capacity than the Cadillac eight. The eight develops the same power as the four at the same speed.

HERBERT CHASE:—You mentioned the difference in cooling in the six as between one cylinder and another affecting the quality of the mixture. Do you think that is really a serious matter in a well designed six?

D. MCCALL WHITE:—I think that the more uniform the temperature, the better will be the results. It has been my experience with six-cylinder motors on the other side of the water that the temperature does not seem to be nearly so uniform as in the four-cylinder type.

HERBERT CHASE:—In connection with the thermostat you say that when the water is cold the pump merely circulates a small amount of water through the carbureter water-jacket from the cylinders, until the water reaches the desired temperature, through the contact with the cylinder walls. Do you mean the water discharged from the carbureter?

D. MCCALL WHITE:—Yes.

HERBERT CHASE:—In other words, there is no circulation through the radiator until the temperature in the carbureter has reached such a point that the thermostat operates and opens the circulating system?

D. MCCALL WHITE:—There always is a very slight circulation of water which is coming from the carbureter, as the pump draws the water from the carbureter itself.

HERBERT CHASE:—In other words, until the temperature of the water coming from the carbureter is raised to a certain predetermined point, there is no other circulation through the radiator?

D. MCCALL WHITE:—No.

CHAIRMAN ANGLADA:—That is, the thermostat is in the carbureter circulation and not in the main circulation?

D. MCCALL WHITE:—Yes.

HERBERT CHASE:—Mr. White spoke of only four connecting-rod bearings on the crankshaft. Of course, in one sense there are only four main connecting-rod bearings, but are there not two other bearings of the forked rod, on the bushing of the central rod?

D. MCCALL WHITE:—No, the forked rod holds the bushing and the center rod oscillates on the center portion of the bushing.

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HERBERT CHASE:—That bushing, I take it, is made of bronze?

D. MCCALL WHITE:—Yes, bronze backing with babbitt metal on the inside.

HERBERT CHASE:—And the inside of the central rod is babbitt?

D. MCCALL WHITE:—No, steel. The bearing is steel on bronze as with the wristpin bushing.

HERBERT CHASE:—In connection with the matter of weight, Mr. White stated that he was of the opinion that under equal conditions one would have to strive very hard indeed to reduce the weight of a six-cylinder engine to eight pounds per horsepower. If it is not out of order, Mr. Chairman, I would like to ask Mr. Crane if he will give us his views on that question. He has designed some very good six-cylinder motors and I believe has obtained a very large horsepower output per unit of weight.

H. M. CRANE:—I think that the first thing to do is to get on a common basis as to what we call weight. Our car has a unit power-plant at the present time, the weight of which is about 1450 pounds. But that includes the starting motor system, the carbureter, magneto, all piping, a four-speed transmission and flywheel running well over one hundred pounds; to which is added a four-inch transmission brake on the front universal, at the back end of the gear-box. I do not know of any way in which I can reduce that to engine weight alone but I think the latter is between 800 and 900 pounds. This engine, with a 66-pound compression, will develop around 110 horse-power. It is not light. The crankcase is a quarter inch thick, at least, and is cast with webs leading out to the frame to take the place of the underpan. We built a small engine for aeroplane work, on the basis of motor car practice, with cast iron cylinders, etc. This engine weighed about 200 pounds and developed 45 horsepower. The old "Dixie" eight-cylinder engine was guaranteed at ten pounds per horsepower, including reverse gear, and we did slightly better than that. It had a bronze crankcase, cast iron cylinders, and was a very heavy job all the way through. It only ran at about 950 r.p.m. I think that eight pounds to the horsepower is not at all difficult to get in any automobile engine, in either four-, six- or eight-cylinder types. As I said before, I believe the four is the best of the lot when it comes to purely a question of weight. But I think it is not a good engine above three or three and a half inches bore where the ultimate of luxury is required.

One of the gentlemen asked Mr. White about the balance of the eight-cylinder engine. I think that perhaps I can help answer that in this way: In the engine under discussion the pistons are very small and I have no doubt extremely light. A four-cylinder engine with pistons of the same weight in the ordinary car would have very little vibration, and in a heavy car the vibration would probably be imperceptible to any one who was not driving. In the eight there are two fours coupled together. resulting in an engine which is nearly twice as heavy. You are dealing, therefore, with a very large mass

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compared with the mass of the moving weights, and the result is that compared to the ordinary vibrations of running the vibrations of the motor are practically unnoticeable. In the case of the De Dion taxicab, the motor of which is four-cylinder, 2⅞ by 3, when seated in the back you can hear it, you can feel the man speeding it in low gear, but cannot feel any vibration at all. The eight, adding four cylinders, would be practically vibrationless as applied to the car. I think, however, that no one will dispute that the elements of vibration would be present in a small degree, due to the angularity of the connecting-rod, which makes it impossible to balance the piston weights. The piston does not move at the same speeds in all corresponding parts of the stroke; that is, in going down an inch from the top it moves at a different speed than in moving up the same distance from the bottom. That being the case it is impossible for the balance to be perfect. That does not mean that the balance is not very good. It is probably better in a well built eight than it would be in a poorly built six.

(To be continued)

Presented at the Winter Meeting of the Society.

AUTOMOBILE WARNING SIGNALS

By Alden L. McMurtry

(Member of the Society)

There is opportunity for the exercise of considerable ingenuity and mechanical skill in developing automobile signaling apparatus, but the basis of any system or appliance of this nature that is destined to meet with lasting success is quite as much a matter of psychology as mechanics. No signaling apparatus can wholly succeed of its purpose unless two phases of the human equation have been properly considered.

The first of these is the fact that in order to serve its purpose as a warning, the signal must penetrate the wall of partial insensibility with which every human being unconsciously surrounds himself by directing his thoughts along some particular line. Were the pedestrian fully aware of the dangers that beset him in the street, he would require no reminder of his peril. But his thoughts are elsewhere, and, for the moment, he is unconscious with respect to his surroundings. As there is a variation in the speed of perception and reaction in different individuals, the signal must be designed for its effect upon the least responsive of those who may still be termed normal.

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There are times when the mere creation of an unusual sound will not serve to warn. In the congested traffic of the city, dangers arise suddenly; a fraction of a second may decide the issue of life or death. The signal in this case must be distinctive in character so as to assert itself positively above all of the other incidental noises of traffic or industry.

Because the subject is one involving public safety very largely, and also because it has never been reviewed in detail, it is believed that the following treatment is warranted. The history and general requirements of audible warnings have been studied, leading up to an investigation of the subject that has come as a later development of the motor-driven diaphragm horn, which is the highest type of signaling device thus far employed for automobile use.

HISTORICAL

"Horseless carriages," as the first motor vehicles were termed, were universally equipped with some form of warning signal long before they had demonstrated their ability to move under their own power. The addition of a large trip gong on the order of fire apparatus conveyed the impression that the carriage would run successfully. Such appliances were usually superfluous, for in most cases the early vehicles themselves made sufficient noise for all warning purposes. The earlier types of American automobiles were fitted with a gong actuated by the foot, as the hands were required to operate all control levers, including, in some cases the brake.

During the year 1899 foreign-made cars were equipped with small reed horns attached to the steering wheel or column. This was a logical signal from the foreigners' point of view, because horns were used abroad for signaling purposes long before the advent of the motor vehicle, and as the feet were required to operate this type of car, signaling naturally had to be done by hand.

REED HORNS

In 1903 the reed horn was the universal signaling device for motor vehicles. In reed instruments the sound emitted by the reed is generally strengthened by resonance. Reed horns all have resonators but in numerous cases little or no attention is paid to resonance between reed and resonator, or the horn proper. The horn was generally selected with an eye to the size of resonator, irrespective of its efficiency. With improved conditions the field of travel of the motor vehicle was enlarged, and the reed horn became ineffective as a safety signal in the country. It was hardly heard around blind curves and corners. The rumble of a wagon on the road drowned out the sound of the reed horn, even at short range. Reed horns are affected by low temperature to such an extent that in extremely cold weather some horns cannot be sounded.

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SIRENS

The year 1905 saw the introduction of the siren. This device was operated generally by a friction pulley which was pressed against the flywheel of the engine. The power was transmitted by means of a flexible shaft or belt. The sirens had an average of eight apertures and required a speed of at least 4,000 r.p.m. before the note became effective. As the rotor of the siren was a considerable mass to accelerate to such a speed, the signal required an interval of at least five seconds before it was at all effective. Even at this rate of acceleration the strain on the flexible shaft often caused it to break.

The note emitted was of a musical character, and, unless the acceleration was sudden, involving abrupt change of pitch, it was an agreeable note to the ear. The great advantage of this device, namely, the ability to sound a continuous signal, made it popular from the start. For the same reason it constitutes an ideal signal for fire apparatus. With the great cost of installation on a car, time required for the sound to become effective and its almost universal use by fire apparatus the siren was, however, soon discarded by car owners.

Various forms or adaptations of the siren principle appeared from time to time. The most popular was the Sireno, which was driven by a small electric motor and fitted with a magnetically operated brake to overcome the flywheel effect of the rotor at the end of a blast. Hand-operated sirens were made but soon discarded, except for fire apparatus. A modification of the steam-driven siren was arranged to be operated from the exhaust of the motor. This, however, required so much pressure that it was ineffective as a signal.

An example of the restrictions now quite generally surrounding the use of the siren may be found in the Connecticut State Law governing motor vehicles. "No person shall use on any vehicle upon the public highways of this State, except upon fire apparatus or upon an ambulance, any siren horn for a signal." A peculiar circumstance in this conection is that such a restriction, in a measure, defeats its own ends. As in the case of sound itself, even scientists have at times difficulty in reaching an agreement as to whether it is the note, or the instrument producing it, to which the designation siren really applies. The sliding pitch tone of the siren instrument can be produced by a variety of other means, by a piston-whistle, for example.

MUSICAL HORNS

A modification of the wind horn known as a musical horn was made in France about 1908. It consisted of four or five reed horns arranged in a musical scale on the order of the bugle. The various reed chambers were opened or closed by a rotary valve operated by the air pressure. Every time the bulb was pressed a different reed was connected, so that the horn gave a variety of notes.

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CONTINUOUS WIND HORNS

A reed horn known as the Autovox is made abroad to overcome one of the drawbacks of the wind horn, by giving continuous, instead of intermittent, blasts. This device consists of a large reed horn with an air reservoir fitted with a safety valve and connected by flexible tubing to a rotary pump operated by the flywheel. The pump was controlled through Bowden wire to a lever placed on the steering-wheel. The advantage of a long blast did not overcome the cost of installation, which in a number of cases was excessive.

COMPRESSED AIR WHISTLES

The sound of a small compressed air whistle mounted on the front of a car is a good close range signal. The Watres device, brought out in 1905, consisted of a compression check-valve which permitted part of the explosion of one or more cylinders to pass into a storage tank. An ordinary low-pressure chime whistle constituted the alarm. About six blasts of the whistle exhausted the tank and until it was fully charged, the cylinder that supplied the pressure developed little or no power to drive the car.

Another form of high-pressure whistle was arranged to be connected directly to one cylinder of the automobile motor. A small poppet valve was used to control the signal. An adjusting screw limited the opening of this valve in order to decrease the loss of power of the cylinder. This whistle was very small and gave a shrill note of very high pitch. Its location under the bonnet of the car, however, reduced the effectiveness of the signal, while the heat of the gas soon drew the temper of the spring and allowed the whistle to blow continuously.

EXHAUST WHISTLES

Exhaust whistles appeared in an experimented way about 1902. Various forms of whistle were made, generally arranged to be connected to the exhaust pipe before entering the muffler. A two-way valve closed the passage to the muffler and opened the passage to the whistle. The effectiveness of the whistle depended upon the position of the throttle of the motor and the location of the whistle on the car. These whistles were quite popular at one time, due mainly to the fact that they permitted a continuous blast and that they were quite musical.

A later form of exhaust whistle was arranged to be connected to the exhaust pipe after leaving the muffler. This whistle was easily applied and gave quite a shrill note. The location of the whistle in the rear of the car not only made it ineffective as a warning signal, but a nuisance as well.

The great majority of exhaust whistles were operated by the foot, thereby limiting their usefulness.

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THE ELECTRIC HORN

The electric horn is a diaphragm horn in which the diaphragm is caused to vibrate by the influence of electric magnets. The dia-

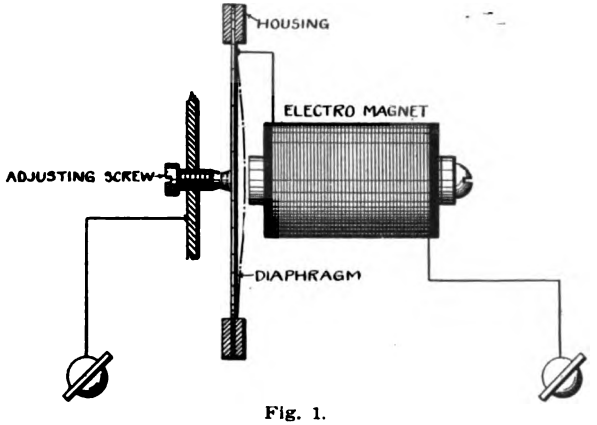

Fig. 1.

phragm itself being of soft iron is attracted by the electro-magnets and carrying one of the contact points in the electric circuit, serves to make and break the electric current. When the circuit is closed at the push button, a magnetic pulls draws the diaphragm toward the magnets. At a certain point on the swing toward the magnets the current is broken at the contact points and the diaphragm is freed. Elasticity carries the diaphragm back to its original position where the electrical circuit is again closed by the diaphragm itself. This type of horn is not new, having been made in France about 1895. At that time it was made to be used in place of electric bells.

A modification of the electric horn employed an armature rigidly fastened to the diaphragm and a contact point carried upon a spring attached to the armature. The addition of this mass of iron lessened the period of vibration while the amplitude was not greatly increased. Various modifications in the principle of the electric horn appeared from time to time, the most noteworthy of which was one in which the diaphragm of a telephone receiver was vibrated by the periodic impulses of current from an induction coil (Fig. 2). The trembler of the induction coil was loaded so as to give a period of vibration or pitch about the same as the reed horn. The secondary winding of the coil was connected to the telephone receiver which was arranged to replace the reed of an ordinary wind horn. While the horn gave a good note, its loudness was not sufficient for practical purposes. Another form of electric horn was made to be operated by the alternating current generated by the Ford type of magneto. However, the tremendous variation in frequency due to the variation in motor speed made this horn inefficient except at certain frequencies or motor speeds.

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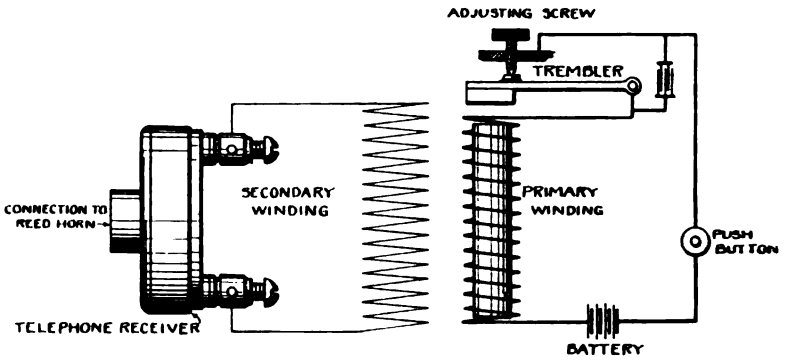

Fig. 2.

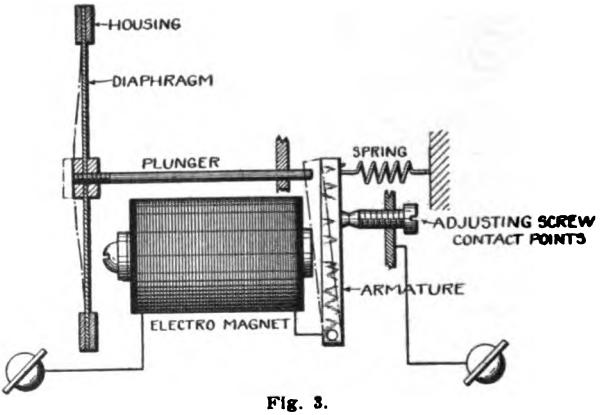

Fig. 3.

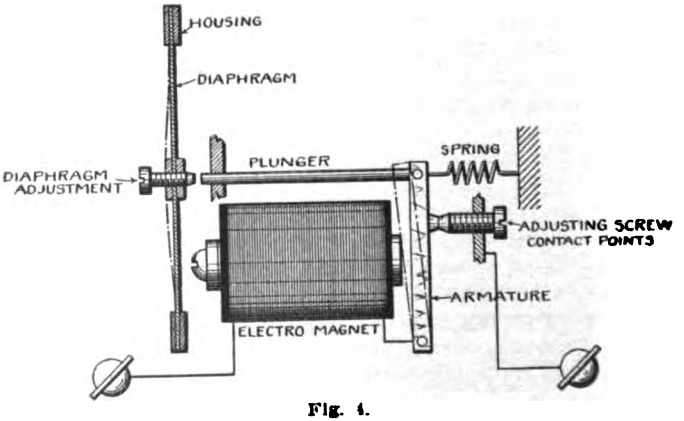

Fig. 4.

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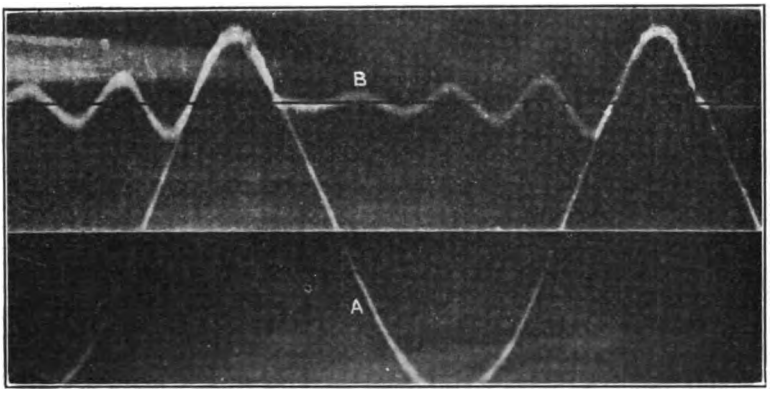

Fig. 5.

The defects of the electric horn, namely, the constant adjustment that was necessary and its limitations with respect to the volume of the signal, soon condemned it for use on automobiles. The advantage of control by a push button which could be located at any part of the car, soon created a demand for a more effective electrically controlled warning signal. About this time the dry cells used for ignition purposes began to be replaced by large capacity storage batteries, so that the current consumption of such an appliance became negligible. Nevertheless, with this obstacle removed, the electric or magnetic horn was still found inefficient as a warning signal and was soon discarded.

ELECTRIC BUZZER HORN

The principle of the electric buzzer horn is the same as that of an ordinary electric bell except that the clapper hits a diaphragm instead of the bell (Figs. 3 and 4). Striking the diaphragm a hammer-blow causes a greater displacement than in the electric horn, but the pitch or frequency is considerably lower. The striking mechanism, such as plunger, armature, spring and contact points, is not connected mechanically to the diaphragm, and is, therefore, not limited by the diaphragm in regard to amplitude of movement or frequency of vibration. The characteristic of the diaphragm (B, Fig. 5) in regard to period of vibration is of little importance in this type of horn, as the sound is produced by the sudden displacement caused by the hammer or plunger. (A, Fig. 5). The pitch of the sound depends entirely on the frequency of the actuating mechanism. The diaphragm, when freed of the hammer, vibrates at its period, but the sound from these free vibrations is not heard because the sensation to the ear of the blow is greater than that of the symmetrical movement of lesser amplitude, that follows. The dimensions of the diaphragm in regard to diameter of the unclamped portion and thickness

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are important, as they govern not only the action of the diaphragm under the effects of the hammer-blow, but its useful life as well. A heavy diaphragm will not be displaced to as great an extent as a light one, while on the other hand a light diaphragm will show gradual distortion at the point of contact with the hammer until it becomes useless. As the period of the diaphragm and its normal position while at rest are not essential in the electro-mechanical horn, almost any method of clamping may be employed.

The actuating mechanism of an electric buzzer horn must have weight or mass in order to impart a blow to the diaphragm with sufficient energy to cause a maximum displacement. The greater this mass the greater will be the displacement of the diaphragm, but at a lower frequency of vibration. Therefore, the electric buzzer horn, like its predecessor, the electric horn, is limited to two types, namely, that giving a loud sound at a low pitch, and that giving a soft sound at a high pitch. To increase the current in an effort to increase the loudness of the sound would increase the blow on the diaphragm and slightly increase the pitch due to a quicker response of the

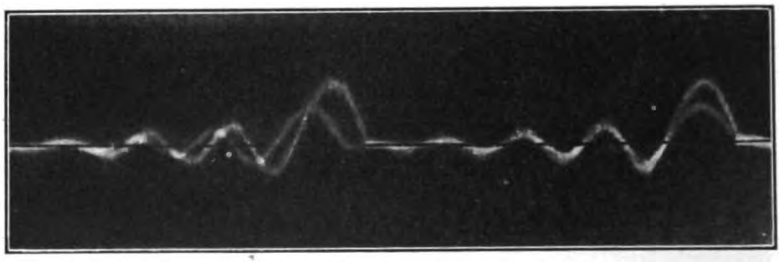

Fig. 6.

armature to the increased magnetic force. (Fig. 6) The return of the armature would be at the same speed as before the current was increased. A heavier spring applied to effect a quicker return of the armature would, on the other hand, only tend to offset the increased magnetic force. In one type of electro-mechanical horn a two-contact push button was used to give two different sounds. A slight pressure on the button closed the circuit through a resistance, while a heavier pressure cut out the resistance. The difference in loudness was noticeable, while the increase in pitch was hardly perceptible.

In order to vibrate the diaphragm of an electro-mechanical horn at a higher pitch than is possible under the conditions of the ordinary automobile installation, it would be necessary to use a device on the order of the oscillator developed by Professor Fessenden for use in submarine signaling.* This device requires an alternating current which for automobile signals is manifestly impracticable.

*Proceedings American Institute of Electrical Engineers. Vol. XXXIII, page 1576, 1914.

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GENERAL REQUIREMENTS OF SIGNAL

Considering the psychological effect of the automobile signal, namely its audibility, two conditions must be fulfilled: It must satisfy the requirments of an emergency alarm, and also those of the more distant cautionary warning. To satisfy the first requirement, that is, to compel the attention of a person at no great distance, it is essential that the sound possess some quality differentiating it from all other sounds. To this end the warning signal may be loud, abrupt, disagréeable or otherwise violent and unexpected in its nature. While careful driving and proper use of signals should make the alarm signal only an emergency requirement, it is obvious that every properly qualified signal should possess that character in some degree. If one man sees another about to be run over by a truck, he does not stop to sing to him, but yells at him in his ugliest and loudest voice.

The second requirement demands only that the sound have carrying power. A further requirement, applicable to both warning and emergency signals, is that the sound shall be as nearly directional as possible and sufficiently concentrated that its zone of influence shall not be unnecessarily wide.

GENERAL REQUIREMENTS OF APPARATUS

In addition to its sound-producing qualities, which will be dealt with in detail elsewhere in this paper, a warning signal must possess certain other characteristics, such as adaptability to a suitable location on the car, with respect to both the direction of the signal and the convenient location of the operating means. It must operate through a wide range of temperature and be absolutely water-proof. Within reasonable limits, it must be economical. It must also possess durability to an extent seldom required of mechanical apparatus.

At least 50 per cent. of all automobile accessories in use are virtually undergoing a breakdown test, for the reason that they usually receive no attention by the motorist until they fail in some way. Signaling devices are no exception; which accounts for so many effective devices operating in an "ineffective" manner. Instruction books are studied only to the extent of learning how to install the apparatus, while if the system happens to be included as regular equipment on the car the instruction book is rarely opened. It is a familiar fact that the less attention required to keep an appliance in good condition, the more it is apt to be neglected. Here the manufacturer of such an appliance is again brought face to face with the bothersome human equation. The practical conclusion, therefore, is that so soon as it is attempted to render a device in any degree automatic or self-sustaining, its future success is practically measured by the length of time it will continue to perform satisfactorily with no attention whatsoever.

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PRACTICAL APPLICATIONS

Having reviewed the requirements of the warning signal and touched upon several points with respect to current practice in the use of such signals, I will now pass to a more detailed consideration of the mechanical signal in order to show how far it goes toward meeting the theoretical requirements of the ideal signal itself, and the practical requirements of every-day service.

THE MECHANICAL HORN

In the mechanical horn the vibration of the diaphragm is accomplished by purely mechanical means. The source of power may be an electric motor, the engine of the automobile or the hand or foot of the operator. In fact, the first mechanical horns used on automobiles were operated by a friction disk pressed against the periphery of the flywheel of the engine.

There are two types of mechanical horn which may be distinguished by the method in which the diaphragm is caused to vibrate. The first is a percussion instrument somewhat on the order of the buzzer horn. In this type a spring is employed to vibrate the diaphragm by means of a blow or "snap." A common form of this type is known as a campaign rattle, and is used more or less as a toy. The diaphragm is pressed from a sheet of tin, in the center of which is attached a small bar of steel. A ratchet wheel is mounted on a shaft made of spring wire (Fig. 7) which permits the ratchet-wheel to spring away from the steel bar on the diaphragm (B, Fig. 8) far enough to free the engaged tooth and allow the next tooth to come into engagement with a snap (C, Fig. 8). The heavier the pressure of the ratchet-wheel against the diaphragm, the more pronounced will be the blow. This type of horn is a noise maker of the simplest order, and was invented to be used (to use the inventor's words) "at such time as noisy demonstration by the people is in vogue."

Another form of horn built on this principle was invented for use on bicycles. It consisted of a diaphragm with a pointer fixed at the center, which pressed against a disk having a roughened or transversely corrugated surface. The disk was revolved by placing it in contact with the rubber tire of the bicycle wheel. This device was never practical. The pointer which pressed against the roughened disk would suffer from excessive wear, as do the steel needles used in the present flat disk gramophones.

In the foregoing described instruments the diaphragm when at rest is pressing against actuating disks and is displaced at its center, which limits the amplitude of vibration. The second type of mechanical horn, which at present is used on about four hundred thousand automobiles, is an instrument the diaphragm of which is caused to vibrate by mechanical impulses applied in harmony with its natural frequency of vibration, acting on the principle of resonance. In this type of mechanical horn, the frequency with which the dia-

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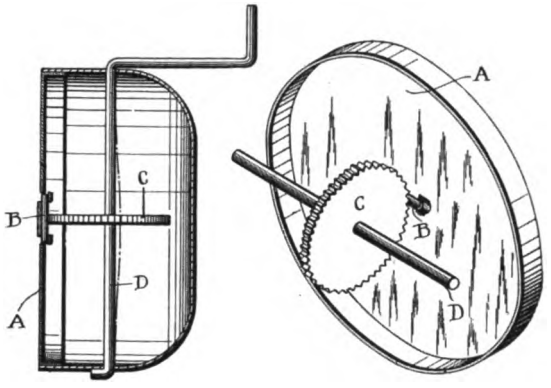

Fig. 7.

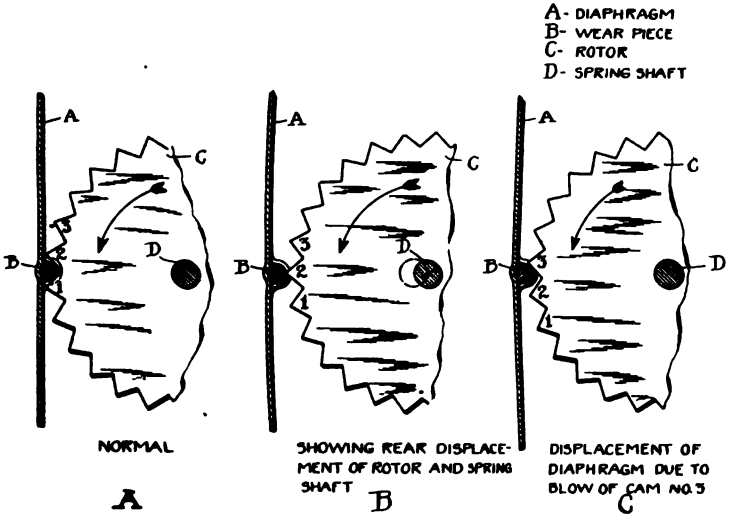

Fig. 8.

phragm will freely vibrate, otherwise known as its natural frequency, is of the greatest importance. It depends upon the material of which the diaphragm is made, its size and thickness and the method of clamping the diaphragm to the case of the horn. The action of the diaphragm in the mechanical horn is not in any way similar to that of telephone or phonograph diaphragms, as is popularly supposed. Telephone and phonograph diaphragms are kept under a buckling stress,

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in the telephone by magnetism, and in the phonograph by spring pressure. Damping is necessary in both cases, because the diaphragms must reproduce correctly sounds varying in pitch up to 4,000 vibrations per second. If these diaphragms were permitted to vibrate freely, the reproduction of sound would be mutilated by the constant effort of the diaphragms to vibrate at their natural frequency. In the mechanical horn every restriction to the free bodily movement of the diaphragm, or damping effect, is eliminated as it is this natural movement which gives the sound, now recognized throughout the civilized world as a warning signal.

In the center of the diaphragm (Fig. 9) is secured a projection or wear piece arranged to receive impulses from a cam wheel, otherwise known as a rotor. The rotor is so placed in relation to the wear piece that the peaks of the cams barely touch it. The movement of the diaphragm when a cam slowly passes the wear piece is not more than two to five thousandths of an inch (0.0508 to 0.1270 mm.)

When power is applied to the rotor, the diaphragm is given a push

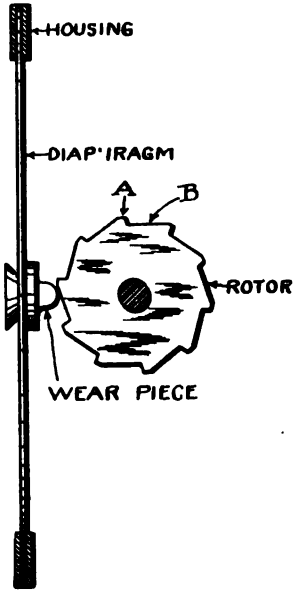

Fig. 9.

by a cam, so that the diaphragm acquires momentum. The inertia of the diaphragm will carry the diaphragm further than the cam itself goes, so that the outward movement is part forced and part free. When the outward movement ends, by reason of the increasing elastic

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stresses opposed to the inertia of the diaphragm, the diaphragm elasticity plus its inertia, sends the diaphragm back again to the rear side of its normal position at rest. While the rotor is speeding up, impacts are given at various intervals, governed largely by chance, according to the accidental times at which the cams strike the wear piece. During this period these accidental collisions produce severe impacts, giving rise to a very irregular and disagreeable noise on the order of the campaign rattle.

When the speed of the rotor has risen so much that the successive cam impacts are closely timed to the natural period of bodily vibrations of the diaphragm the impact of the cams with the wear piece produces a rapid increase in the amplitude of the diaphragm movement. When the speed of the rotor or the number of cam pushes is properly harmonized to the vibration of the diaphragm, the ear perceives a recognizable musical note. The push of the cam is of a different velocity from the natural sine-wave rate of change with which the diaphragm wishes to move. Otherwise, there would not be a forcing of the diaphragm. The forced part of the movement of the diaphragm must be slightly faster than its natural rate in order to impart any power to the diaphragm movement. This acceleration of one part of the otherwise natural movement shortens the total time, but the forced movements and the natural movement are of the same frequency, even though their velocities and duration are not the same. This represents the normal operating speed of the rotor. If, however, more power is applied to the rotor, it will transfer more power to the diaphragm rather than increase its speed of revolution. This action is known as the governing effect of the diaphragm on the speed of the rotor.

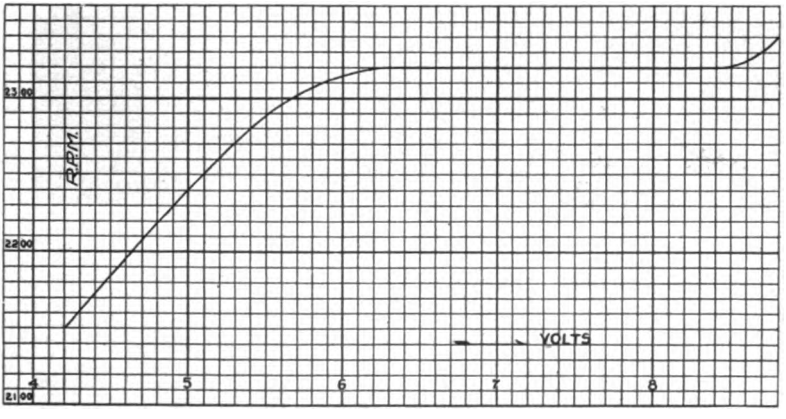

Fig. 10.

In Fig. 10 is shown a curve indicating that increase of current has no effect on the speed of the motor. The increase in current causes

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the cam to overtake the diaphragm a little sooner (B, Fig. 9), resulting in wider amplitude of diaphragm swing and a slight increase in the pitch by reason of the increased speed of the outward forcing part of the movement. At the normal operating speed, a cam of the rotor pushes the diaphragm *after* it has *started* on the outward swing, so that if the cam pushes the diaphragm any sooner it will meet it at the end of the inward swing at rest. A greater increase in current will cause the cam to *stop* the diaphragm on the inward swing and suddenly start it on the outward swing.

The governing effect of the diaphragm on the rotor acts on the order of the pendulum governing the speed of the clock movement.

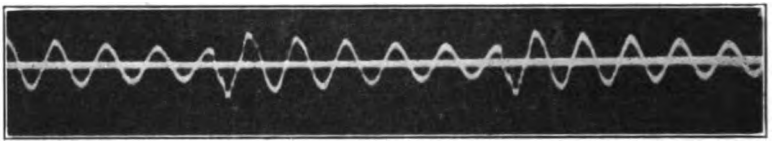

Fig. 11.

Fig. 11 shows the movement of a diaphragm caused by a rotor with but one cam. It shows that the diaphragm is forced outward by the cam and then permitted to vibrate freely until again pushed by the cam. This occurs at a time when the diaphragm has just completed the inward swing and is starting on the outward swing. If the cam push was slightly earlier, the force of the push would be so great as to reduce the speed of the rotor so that the next cam push would be properly timed. Fig. 12 shows the normal action

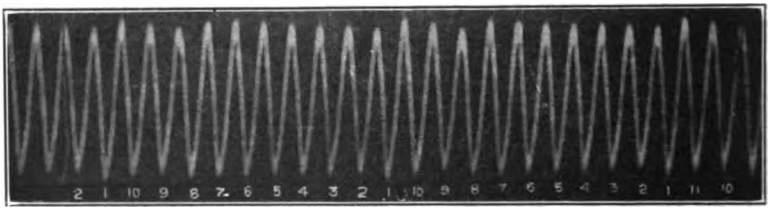

Fig. 12.

of a diaphragm with a ten-tooth rotor. This photograph was made with an extremely low film speed in order to compare the action of the different cams of the rotor. It will be noticed that cam No. 1 gives a slightly greater push than the others.

Under the conditions of increased current or overload, the diaphragm does not vibrate symmetrically as the portion surrounding the wear piece is greatly distorted, due to the terrific blows of the cams. (Fig. 13.) This distortion lessens considerably the life of the diaphragm and in extreme cases will destroy it within a short time.

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Fig. 13.

In some types of motor-driven mechanical horns the diaphragms are purposely overloaded with rotor power in order to get a louder and more distinct sound. Under these conditions the diaphragm will not survive three to five thousand signals.

When the power applied to the rotor is shut off, the vibrations die away rapidly, the irregular collisions and impacts begin again, producing an irregular noise, as when the power was first applied, until the rotor comes to rest. If the power supplied to the rotor is insufficient the collisions occurring during its acceleration will *not be so pronounced*, and there will be a slight interval of time between the final collision stage and the point of resonance between diaphragm and rotor. The sound under these conditions will lack to a certain extent the characteristic note of the mechanical horn as the push of the cam against the wear piece of the diaphragm is reduced. If the adjustment of rotor in relation to diaphragm is greater than 0.005 inch (0.1270 mm.) the effect of the collisions will be greater and the acceleration to note will be slower. Too heavy an adjustment will not permit the rotor to attain full speed, and therefore puts the horn in the class of percussion instruments.

Cracks in the diaphragm will naturally impair its elasticity and result in absolute lack of collisions. The note of a cracked diaphragm resembles the siren in the gradual rise of pitch to the point of resonance when the sound is not unlike that of a cracked bell. Cracks in the diaphragm of a well made horn are the result of fatigue and appear gradually but the destruction of a diaphragm caused by excessive rotor power is sudden and complete.

MECHANICAL CONSTRUCTION

While the principle of operation of the mechanical horn is comparatively simple, its construction is an entirely different matter.

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Of greatest importance is the diaphragm and its relation to the rotor, which determines the. usefulness of the instrument in terms of the number of effective signals before destruction. Diaphragms covering a wide range of physical qualities will apparently behave alike until subjected to a breakdown test to determine the number of signals. Some diaphragms crystallize and crack in less than one thousand signals while others have withstood two hundred thousand signals before showing defects. There are other factors than the material from which the diaphragms are made that determine their life, the most important of which are method of manufacture, clamping, form, location and method of attaching wear piece. Another very important point regarding the behavior of the diaphragms is their normal position of rest. The over-lap of the cams of the rotor in relation to the wear piece, as previously stated, is approximately 0.002—0.005 inch. This light adjustment permits the rotor to quickly accelerate to normal speed. If there is a variation in the normal position of rest a heavier adjustment is required to assure cam contact with the wear piece of the diaphragm which in itself imposes a high starting torque on the motor. The same is true if irregularities exist in the heights of the cams of the rotor. The size and shape of the wear piece with respect to the characteristics of the diaphragm are of great importance in order to get a full bodily displacement without reverse bending or warping.

There are additional details of refinement in the construction of the mechanical horn which affect to a great extent its efficiency and life, but which for obvious reasons cannot be recorded in this paper. Suffice it to say that one type of mechanical horn alone has received as much detailed study and laboratory research work as any accessory of the modern automobile.

The electric motor which drives the rotor must be designed with a speed-torque curve that will best meet the conditions imposed by the diaphragm and perform its duty for a long period without any attention or care. In some cases such motors have actually given two to three years of service without receiving the slightest attention.

RESONANCE

The term resonance signifies the production of a natural swing or vibration by the action of a periodic force. The ideal case of resonance is where both sounding and responsive elements possess the same natural period of vibration. Remove the reed from a reed horn and blow it by the mouth and the sound is entirely different from that produced when the reed is placed in the horn or resonator. If water be poured into the resonator it will alter the pitch and destroy the resonance. From this it follows that the resonator fulfills a most important function in "re-inforcing the tone" and conversely, that if the resonator is not properly tuned to the sounding element the resulting tone will be produced inefficiently. In a number of

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cases, the resonators of warning signals are designed merely to improve the apearance of the instrument. The siren, for example, has no fixed pitch; therefore, the addition of a resonator is simply a matter of looks.

In the mechanical horn, the resonator should have a pronounced natural frequency. The air column within the resonator will control and determine the natural frequency of the diaphragm to some extent but obviously the effectiveness of the signal will be enormously greater where the natural frequency of the air column is selected so as to be the same as the normal full speed note of the bare diaphragm.

CONTROL OF THE ELECTRICAL SIGNAL

Various attempts have been made to effect a control of the signaling device so that two different sounds would be obtained. The efforts were generally centered in the electrical push button, the amount of current being regulated by pressure on the button. Other types were made in the form of time limit contacts. A light pressure on the button would close the electrical circuit only for a fraction of a second while a heavy pressure would keep it closed. All these devices were complicated and limited the reliability of the signal to a great extent. The simplest form of push switch is the best because it must be reliable and close the circuit with the least electrical resistance while withstanding in some instances very severe blows. The operation of the button, like that of the accelerator or clutch pedal should be a sub-conscious effort on the part of the driver. For this reason the button should be located in a fixed position and not, for example, on the rim of the steering-wheel, where its location is subject to change. The modern method of mounting the button in the center of the steering wheel, on the other hand, is ideal, since it involves a permanent installation in a location equally accessible to either hand.

HAND-OPERATED DIAPHRAGM HORNS

The hand horn, as it is commonly known, is a mechanical horn operated by pressure of the hand on a plunger or lever, although some hand horns are made to be operated by turning a crank or wheel. The advantage of the hand horn is that it is a unit in itself, the same as the bulb horn. The duration of blast is approximately the same as that of the bulb horn. The characteristic note of the hand horn varies with the make of the horn. The overlap or adjustment between rotor and diaphragm in the majority of cases is very heavy, which classifies the horn as a percussion instrument. One and possibly two makes employ a light adjustment in order to get the fully bodily swing of the diaphragm and charactistic note of the motor-driven mechanical horn.

While the hand-operated horn has the advantage of not being dependent upon any source of external energy, its position on the

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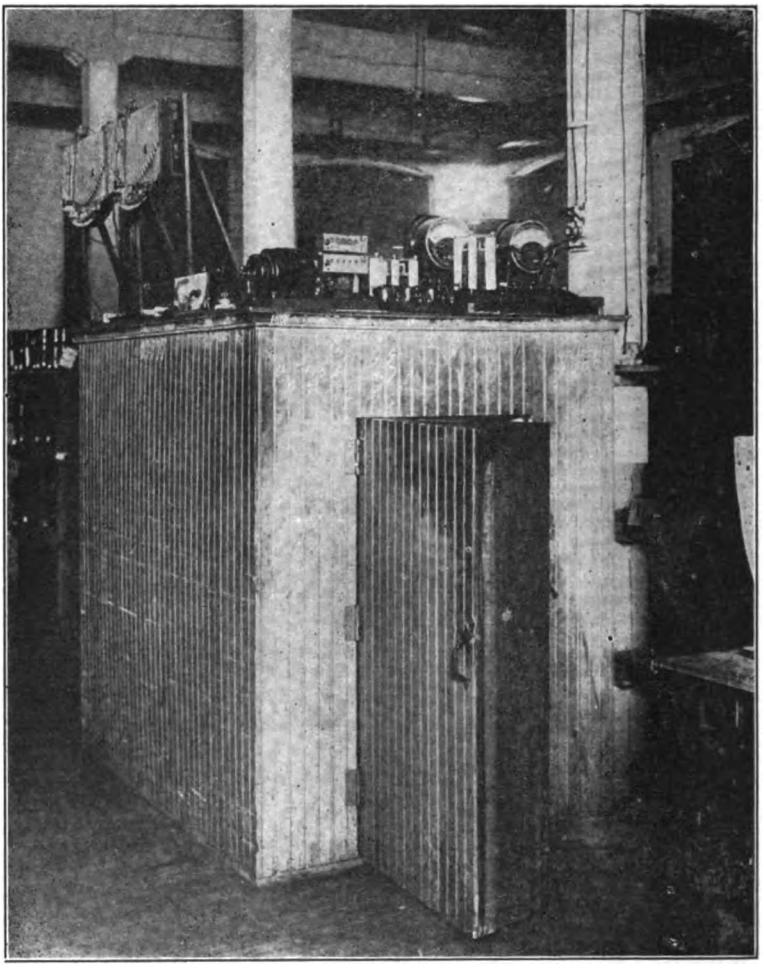

Fig. 14.

car is limited. It must be placed within effective reach of the driver, so that it may be operated with the same facility as the electrical push button. It is also necessary that the operator be able to deliver a powerful push on the plunger or other operating device in whatever position it may be placed. At the same time it should be located in a position so that the sound is unobstructed by the windshield or other parts of the car.

In some truck installations a horn of this type has been arranged to be operated by foot pressure. This has the disadvantage of limiting the signaling to moments when the feet are not engaged in

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operating the controls. Another point against this location is that the horn mechanism is not made strong enough for foot operation and three or four powerful kicks on the plunger will strip the train of multiplying gears in the horn. Hand horns, like all other forms of mechanical signal, suffer from lack of lubrication. The almost universal adoption of electric starting systems will make the motor-driven mechanical horn more popular than ever before.

TESTS OF SIGNALS

It is absolutely necessary to subject various signaling devices to breakdown tests in order to establish their reliability. Practically nothing is determined by a test consisting of one continuous blast; while on the other hand, a test of the number of short blasts a signal will give without adjustment produces most valuable data. In the motor-driven type of mechanical horn the motor itself will be subjected to greater effort in repeated starting than in one continuous run. The commutator and brushes are subjected to a series of overloads. The greatest strain on the diaphragm wear piece and rotor occurs in the starting of a blast. Obviously in a continuous test of a horn of this type practically the only data obtained would be in regard to the wearing qualities of the commutator and bearings. It can be readily seen, therefore, that it is the number of short blasts a signaling device will give without adjustment that determines its usefulness in practical operation. Or, to put it another way, unlike certain other classes of mechanical appliances the most effective service implies maximum demand upon the mechanism. Fig. 14 is a photograph of a testing box which is arranged to reduce the sound of a horn under test so that it is barely audible. Mounted above the box is the necessary apparatus for recording the number of blasts, current consumption and other details regarding test.

POSITION OF SIGNAL ON CAR

During the last year for the first time consideration has been given by the automobile engineer to the position of the signaling device on an automobile. It was only competition that caused cars to be sold with full accessory equipment. It then devolved upon the automobile engineer to install this possibly inefficient equipment in the most capable manner possible. The position of the signaling device was determined by the limitation of the device itself. Recently accessory devices have been made with particular makes of cars in view. This refinement has not only insured the permanency of the location but the more efficient operation of the instrument. Of late there has been a tendency toward placing the signaling device under the hood in order to give the exterior of the car as clean an appearance as possible. In this position the sound from the instrument is restricted to a large extent, and in some cases loses its abruptness. Another point regarding this location is that in the case of a closed car the sound is more offensive to the passengers.

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As an apparatus, this form of horn answers the requirements of being subject to any location desired. It should preferably be

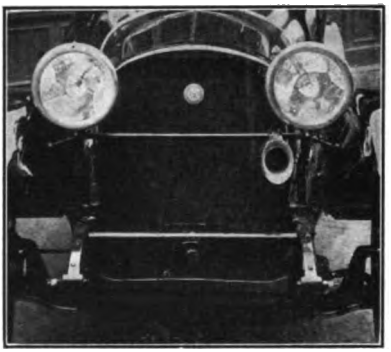

Fig. 15.

mounted in front of the radiator (Fig. 15) where its sound is most effective and least objectionable to the passengers. The possibility of locating the horn button at any desired point has further advantages.

SIGNAL ABUSE

There has been considerable agitation in the trade papers in England lately regarding loud signals, especially within town limits during the night hours. This is probably caused by the injudicious use of mechanical horns, which, in a number of cases, are used as excuses for reckless driving. In this country some of the States have laws which specify that "every motor vehicle which shall produce a suitable bell, horn, or other signaling device which shall produce an abrupt sound sufficiently loud to serve as an adequate warning of danger, but no person operating any motor vehicle shall make, or cause to be made, any unnecessary noise with such bell, horn or signaling device or use the same except as a warning of danger." It is seldom necessary to operate a loud signal for a longer period than two seconds. There are some types of buzzer horns, the sound of which is not distinctive as a warning. They require, therefore, a series of continued blasts before becoming effective.

CONCLUSION

It will thus appear that in nearly every respect the mechanically operated diaphragm horn is an ideal form of automobile warning signal. Due to a happy combination of circumstances its sound approaches more nearly the ideal than that of any other instrument of the same kind. During the period of action in which the rotor is coming up to speed and getting into phase with the natural period of the diaphragm, there is produced a disturbance that is almost entirely inharmonic, and which, because of its peculiarly rough and

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abrupt character, is both distinctive and alarming if heard close at hand. This portion of the operation of such a horn is admirably suited to the purposes of the emergency signal. If the circuit be kept closed long enough for the rotor and diaphragm to get into phase, however, there is produced a powerful fundamental wave that is of great carrying power.

It is possible to construct such a horn in a manner comparable with that of any other part of the car, so that with a minimum of attention it should have a life expectation equal to that of the car as a whole. Where a source of electrical energy is available, its cost of operation is negligible. Its only disadvantage is in first cost, which, considering its advantages in other respects is low, when spread over the total term of its usefulness.

In conclusion, I desire to emphasize again the point that the abuse of signaling devices is exceedingly prevalent, and that it results not only in annoyance to the public, but breeds confusion, tends to cause signals to be ignored, and often defeats the purpose of the cautious driver whose whole effort is in the interests of safety. This is due mainly to the indiscriminate use of long blasts, which, as has already been shown, are of less value for signaling than short blasts. Such confusion can be eliminated in only one way, namely, by universal custom or habit. The value of a warning signal is seriously impaired by reason of the fact that it is frequently used for the purpose of a door bell when the car is standing by the curb, as an alarm clock for sleeping garage attendants, and as a plaything for street urchins.

In a certain sense, the warning signal may be said to constitute the only bond of common interest between the motorist and the public. It is the means whereby the motorist in an emergency may impart a warning of danger. In its peculiar function in guarding the public safety, therefore, it is deserving of more attention than it has received heretofore.

DISCUSSION

WILLIAM SPARKS:—The front of a car is a very poor location for a signal, as it will accumulate rain, snow and mud there. Mr. McMurtry states "Of late there has been a tendency toward placing the signaling device under the hood, in order to give the exterior of the car as clean an appearance as possible." That is the proper place for it. The sides of the car should be clean. He states further "In this position the sound from the instrument is restricted to a large extent, and in some cases loses its abruptness." That is true only if the type of bell shown in Fig. 15 of his paper is used. Quoting further, "In a number of cases the resonators of warning signals are designed merely to improve the appearance of the instrument." That applies to the one that you see on the front of the car in Fig. 15. If a straight tapered bell resonator is used instead of an oval bell, 25 to 33 per cent. greater volume, that is, carrying capacity, can be secured.

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Therefore, although the sound is somewhat restricted by placing the horn under the hood, as much volume can be secured as with the oval bell on the outside of the car.

ALDEN L. MCMURTRY:—The signal shown in Fig. 15, referred to by Mr. Sparks as having an inefficient resonator, is of the same type as the signal used to demonstrate the efficiency of a resonator during the presentation of the paper. The increase of 25 to 33 per cent. of volume is simply a matter of opinion and cannot be substantiated by actual test.

R. H. MANSON:—I have had made a hasty survey of the cars on exhibit at the Palace and find that out of 217 examined, 189 had warning signals mounted under the hood, 22 on the side of the car, and 6 at the front in a position adjacent to the lamp or the front of the radiator. I found also that about 138 cars had the button located in the center of the steering-wheel, 48 at the side or on the door inside of the body, 13 on the steering-column (most of these being located immediately under the steering-wheel), 10 on the instrument board in most cases very close to the steering-wheel). There were about 8 miscellaneous button locations, some below the seat cushion. I found that there were 211 electric warning signals, 5 reed horns and 1 hand-operated mechanical horn. Sixty-seven different makes of cars were examined.

The car makers having large production exhibited the vibrating type of warning signal exclusively. Inasmuch as many manufacturers are using the vibrating type of horn, I would like to say a few words in regard to it, especially the modern vibrating horn. There was a time when the vibrating horn was nothing more than a door-bell mechanism located in an enclosure of some kind, with a projector placed in the front to give it good appearance. At the present time in certain designs of vibrator horn resonance is taken into consideration, as well as the natural period of vibration of the diaphragm and various other elements which help in producing an instrument giving a signal with a small expenditure of energy and at the same time very uniform in action. I have made a good many experiments to determine the best methods of testing these signals in the factory to get the same results as when mounted on cars. In these tests I find that the voltage of the modern car battery varies from about 5.5 to 7.6 approximately. The old type of electric signal was designed for a six-volt battery, but we have to contend now with a considerable variation of voltage. When a vibrating type of signal is properly designed it is found that if the diaphragm-actuating element and the column of air in the resonator are properly attuned, the only difference in the character of the signal for the range of voltage mentioned will be in the loudness. Other points in connection with the modern type of vibrator horn are that it can be produced so as to be reliable, require only occasional adjustment, and stand more abuse, possibly, than an instrument which has bearings and cams and a few other moving parts.

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Three points should be brought up in connection with warning signals, and some sort of standard which can be used by the different manufacturers worked out.

First, the location of the operating button should be standardized so that a driver or an owner purchasing different makes of cars will not have to learn where to reach for the signal button. This is very important.

Second, the location of the horn should be standardized. I think it has been demonstrated that the underhood horn is the correct type to use.

The third and most important point to standardize is the type, shape and drilling of the mounting bracket. A person purchasing a moderate-priced car equipped with a horn not up to the particular requirements, should be able to replace the signal readily. At the present time it is an extremely difficult job to do this, and usually requires a mechanic.

Presented at
Detroit Section Meeting.

A COMPENSATING SPRING SUSPENSION

BY ERNEST E. WEMP*

It is a well-known fact that the human organism is very susceptible to vibration of any character, particularly when the period of the vibration is high. Vibration, due to road inequalities, is both the principal cause of passenger discomfort and the agent of destruction to the entire mechanism, and is the primal reason for the spring suspension of vehicles. It is reasonable to consider that passenger comfort is the true criterion for judging the road performance of a suspension system.

The movements of the axle systems of a vehicle must conform closely to the contour of the roadway they are traversing, thereby setting up rapid accelerations and retardations of the masses in the axle systems. In fact, it can be shown readily that in cars of standard design, disregarding the shock-absorbing effect of the tires, a vertical acceleration of the axle system of 550 feet per second per second may be easily obtained, and it is by no means certain that under conditions where the tire is releasing previously stored energy at the instant the shock occurs the vertical acceleration may not reach the above-given figure even with the use of pneumatic tires. An acceleration of 550 feet per second per second is 17 times that of gravity

*M. D. Hubbard Spring Company, Pontiac, Michigan.

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and it is evident that if it occurred in the passenger-carrying platform the effect would be intolerable.

While it is obvious that the ideal conditions for passenger comfort would be obtained by maintaining a constant platform level, it is likewise an established fact that platform movements do of themselves not necessarily mean passenger discomfort. It is only when these movements become rapid in period, causing sudden changes in direction and consequently rapid platform accelerations, that the action becomes uncomfortable to the passenger and racking to the entire mechanism. The ultimate object, then, of a successful suspension, regardless of the means employed, is to maintain platform vibrations of low period and consequently low accelerations and retardations.

Passenger comfort in spring-suspended vehicles is inversely proportional to the vertical accelerations and retardations of the passenger-carrying platform. The accelerating force of the mass of the axle system must be absorbed by the mass of the platform supported by it. Since acceleration is proportional to the mass, when a given force is considered, it is evident that the ratio of the unsprung mass of the axle to the mass supported by it should be as small as possible. From this the second fundamental may be expressed. Other things being equal, passenger comfort is inversely proportional to the ratio of the unsprung to the sprung weight of the vehicle. The qualification, "other things being equal," is inserted because many other conditions affect passenger comfort, the principal ones being:

Length and periodicity of springs.
Diameter of wheels.
Size and degree of inflation of tires.
Wheelbase of vehicle.
Depth of cushions and quality of upholstering.

While the last-named factors influence road performance to a large extent, these remarks are based upon the first two fundamentals, and in any comparison between the compensating suspension and those of conventional design it is to be understood that as regards wheelbase, diameter of wheel, size of tires and period of spring vibration the vehicles are similar.

An analysis of the roadway over which a vehicle travels may also assist in giving a clearer understanding of the fundamentals of the suspension itself. A roadway consists of an equal number of elevations and depressions relative to a mean roadway. These may be termed positive and negative obstructions, since they induce axle accelerations opposite in sign. It is evident from the law of average that 50 per cent. of the obstructions, simultaneously encountered by the axle systems must be opposite in sign, and, therefore, induce in the axle systems forces opposite in direction. The platform mass must absorb these. Why not arrange the suspension system so that the opposing forces can be made to counteract each other and thus reduce the resulting effect on the platform?

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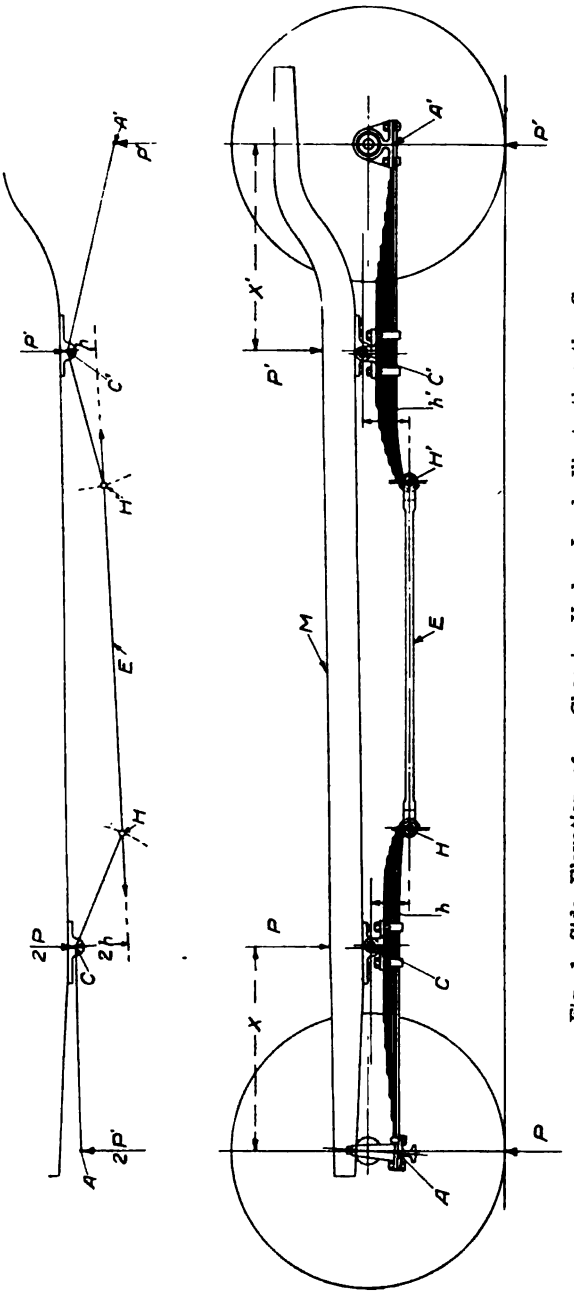

Fig. 1—Side Elevation of a Chassis, Under Load, Illustrating the Compensating Spring Suspension.

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Fig. 1 is a side elevation of a chassis embodying the Wemp compensating spring suspension. The front and rear springs are of the half-elliptic cantilever type, pivoted intermediately to the platform *M* at the pivot points *C* and *C'*. The outer ends of the springs are connected to the front and rear axles respectively, and the inner ends are linked together by the tie-rod *E*. *P* and *P'* represent the load or force in pounds applied at the points *C* and *C'*, due to the weight of the platform and its load. *P* and *P'* likewise represent the vertical reactions at the front and rear-axle systems respectively.

Considering the points *C* and *C'* to be the pivots of the link work, then the force *P* creates a turning moment about *C* equal to $P\ X$ and an unbalanced force at *H* equal to $\frac{P\ X}{h}$, where *X* is the moment of the force *P* and *h* the perpendicular distance from *C* to a plane passing through *H* and *H'*. Likewise *P'* creates a turning moment about *C'* equal to $P'\ X'$ and an unbalanced force at *H'* equal to $\frac{P'\ X'}{h'}$.

The unbalanced forces at *H* and *H'* are opposing, and equilibrium of the system can be produced by connecting the opposing forces through the medium of the tie-rod *E*, when the force at *H* equals the force at *H'*.

The condition for static equilibrium may, then, be expressed algebraically by the equation

$$\frac{P\ X}{h} = \frac{P'\ X'}{h'}.$$

An analysis of the system shows that the springs, together with the tie-rod *E*, form a draglink system in which a constant angular velocity of bellcrank *A C H* will produce a variable angular velocity of bellcrank *A' C' H'*, and *vice versa*. Likewise the *leverage-ratio* of *P* : *P'* will vary with the angular movement of the bellcranks; for example, as (upper) bellcrank *A C H* is rotated about *C*, the value of *h* is increased and the value of *h'* at the same time decreased, until they are in the ratio of 2 : 1 or $h = 2\ h'$. The equation for momentary equilibrium then becomes $\frac{P\ X}{2\ h'} = \frac{P'\ X'}{h'}$, and, since the values of *X* and *X'* vary with the cosine of small angles and therefore but little, they may be neglected without serious error and the equation becomes

$$\frac{P}{2\ h'} = \frac{P'}{h'} \text{ or } P' = \frac{P}{2}.$$

That is to say, in the *new* position, the load at *P* must be twice as large as the load at *P'*, in order to maintain equilibrium. The

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system, then, is capable of automatically accommodating itself to changes of load, applied at any point on the passenger-carrying platform.

Any spring suspension depends upon the inertia of the platform mass for its action. The inertia of the mass has the identical effect of increasing or decreasing the weight upon the springs, and if this fact is borne in mind the action of the compensating suspension under road shock is very readily understood.

There are three important conditions of road shock:

First, a shock, either positive or negative, occurring at one axle only.

Second, shocks, either positive or negative, occurring simultaneously at both axles, the shocks both being of like sign.

Third, shocks simultaneously occurring at both axles, of opposite sign.

As an example of the first condition, consider a positive shock as occurring at the front axle system. Since the shock is positive, the vertical accelerating force is upward and a downwardly resisting force is induced by the inertia of the mass of the platform supported by the front axle. This is the equivalent of suddenly increasing the load at C from P to P_2 lbs. The equilibrium is thereby disturbed, causing the bellcranks $A\ C\ H$ and $A'\ C'\ H'$ to rotate until the equation $\frac{P_2\ X}{h} = \frac{P'\ X'}{h'}$ satisfies and momentary equilibrium is restored. It will be noticed that in order to make the force P' balance the increased force P_2, it is necessary that h shall increase and h' decrease in value. As h' decreases in value, the point A' would tend to move downwardly, but since A' is in contact with the ground, the pivot point C' will be raised instead, thus raising the platform at the rear. If the shock force at A is greater than the inertia resistance of the platform at C, the front end of the platform will likewise be raised.

The total effect, then, of the shock force occurring at one axle system only is to raise the *whole* mass of the platform.

If the shock were negative the effect would be similar, but opposite in direction and both ends of the platform would be lowered.

As an example of the second condition, consider positive shocks occurring at both axles, the greater of the two at the rear. As a positive shock has the effect of increasing the platform load, both P and P' are increased to P_2 and P'_2. As before, the equilibrium is disturbed with a consequent *raising* of the platform at the end of the *lesser* resistance, in this case the front end of the platform.

If both of the shock forces are large enough to overcome the inertia resistance of the platform, the resulting action will be a raising of the rear end of the platform by the action of the larger force and a raising of the front end by the *combined* action of the smaller force and the action of the equilibrium means. If the

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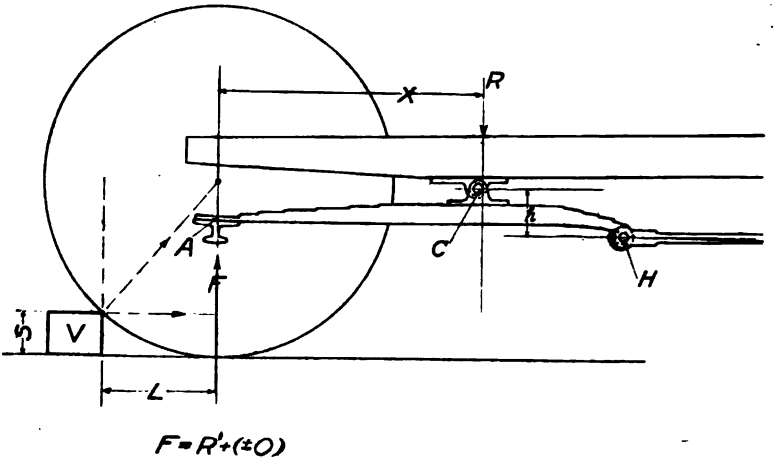

Fig 2—Side Elevation of Front End of Chassis—Wheel Encountering an Obstruction.

forces were both negative, the platform action will be similar but opposite in direction.

As an example of the third condition, consider a negative shock occurring at the front axle and a positive shock simultaneously at the rear axle, the positive shock being the greater of the two. The action in this case will be easier to follow, if the forces are considered separately and the results combined. The negative force occurring at the front axle system would cause a lowering of both ends of the platform, since this is the action resulting from a shock of the first condition. The positive force at the rear axle system would cause a raising of both ends of the platform, as it is also the effect of a shock of the first condition. Since these positive and negative forces occur simultaneously, the resulting force tending to accelerate the platform is the algebraic sum of the two opposing forces.

In order to show mathematically the division of the work done upon the platform under shock conditions, it will be necessary to use another method of reasoning than the one given above. Fig. 2 shows diagrammatically the front axle system encountering a positive obstruction V which is S inches in height. T represents the time in seconds required for the wheel to mount the obstruction, or to travel through distance L inches. The vertical component of the shock forces is a variable maximum in value at the moment of impact and decreasing to zero as the obstacle is surmounted. Its mean value may be represented by the force F, which acts through S inches in T seconds.

The inertia of the platform induces a resisting force acting downwardly which is likewise variable and may be represented by a mean

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force R, opposite in sign to F, and also acting through T seconds or the time required to surmount the obstacle. Both of the forces F and R are known forces (that is, they are measurable, if elasticity is considered lacking in the wheels), and of them it is known that they both act through the same length of time—T seconds—and that the force F acts through a space of S inches. Since the space through which the force R acts is not known, it is evident that, with the kinetic relations given, no direct expression of work between the two can be made. The force F may be considered as consisting of two components R', opposite in sign to the known force R, and O, where O is the algebraic difference between F and R'. This relation may be expressed by the equation

$$F = R' + (\pm\ O).$$

Since the time and space through which F acts is known, the impulse and the work done by F are known; and it is necessary to assign to the components R' and O the same values of time and space, so that all of the kinetic relations of the force F and the sum of its components will be equal. These are expressed by the equations,

1. Force $\quad F = R' + (\pm\ O)$
2. Impulse $\quad F\ T = R'\ T + (\pm\ O\ T)$
3. Work $\quad F\ S = R'\ S + (\pm\ O\ S)$

Of the two forces R and R', it is known that they both act through T seconds and are opposite in direction, and R' is *now* assumed to be equal to R in magnitude.

It will now be well to eliminate the force F and substitute its components, considering each one as acting individually and combining the results. Consider, first, the component R' acting at A. It is resisted by an equal force R acting at C and produces a couple, whose arm is X. The moment of the couple is $R'\ X$, and an unbalanced force at H equal to $\frac{R'\ X}{h}$ is created. This unbalanced force is transmitted through the medium of the tie-rod to the rear bell-crank (rear-spring) and expended in acting upon the mass of the platform opposite the shock. It is seen that the force R becomes the vertical resistant to the force R' during the T seconds it acts, and is totally expended at the instant R' is expended. Therefore, there is no vertical movement of the pivot C from the force R'. All of the force R' is thus seen to be transmitted and expended in acting upon the end of the platform opposite the shock.

Now R' is R' parts of F; therefore that portion of the shock force that is transmitted to the end of the platform opposite the shock is expressed by the ratio $\frac{R'}{F}$.

The component R' being totally expended (likewise the resistant R) the component $\pm\ O$ may now be considered. The com-

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ponent $+ O$ applied at A, finds no resisting force at C (since the total resistance possible has been expended). Therefore, there is no turning moment about C and all of the component $\pm O$ is expended in acting upon the mass of the platform supported at C, or the end adjacent to the shock.

$\pm O$ is $\pm O$ parts of F; therefore, that portion of the shock force acting upon the end of the platform adjacent to the shock is expressed by the ratio $\frac{O}{F} = \frac{F-R'}{F}$. Since $\frac{R'}{F}$ and $\frac{O}{F}$ are the ratios of the division of the shock force F to the ends of the platform opposite to and adjacent to the shock, it is clear that by multiplying the ratios by the common space factor S their values are not changed, and

$\frac{R' S}{F S} = \frac{R'}{F}$ = ratio of *work* done at the end opposite to the shock,

and

$\frac{O S}{F S} = \frac{O}{F} = \frac{F-R'}{F}$ = ratio of *work* done at the end adjacent to the shock.

Numerically speaking, the forces R' and R are equal, and so, neglecting the direction of the forces, $\frac{R}{F}$ = ratio of *work* done at the end opposite the shock.

$\frac{O}{F} = \frac{F-R}{F}$ = ratio of work done at the end adjacent to the shock.

The action of the system is thus seen to depend upon the value of R, that is, upon the inertia of the platform at the end receiving the shock.

In encountering a series of obstructions, it is evident that R may have a value due to a previous shock. Likewise its value may be positive or negative. If the value of R' in the equation is made of opposite sign to that of R, the equation $F = R' + (\pm O)$ will satisfy.

From the above explanation shocks occurring separately or simultaneously may be analyzed, remembering to treat the shocks as occuring individually and combining the results.

In all of the explanations of the system the element of friction has been neglected. It was found during the experimental work that this element affected the working of the system to a marked degree. This fact led to the development of a type of bearing which has proved very satisfactory. It has merits worthy of a detailed explanation. Fig. 3 shows in detail the rear pivot bearing of the suspension. It will be noticed that the bearing bracket B, attached to frame F, is finished with a bell-mouthed hole of at least 1.5 times the diameter of pivot

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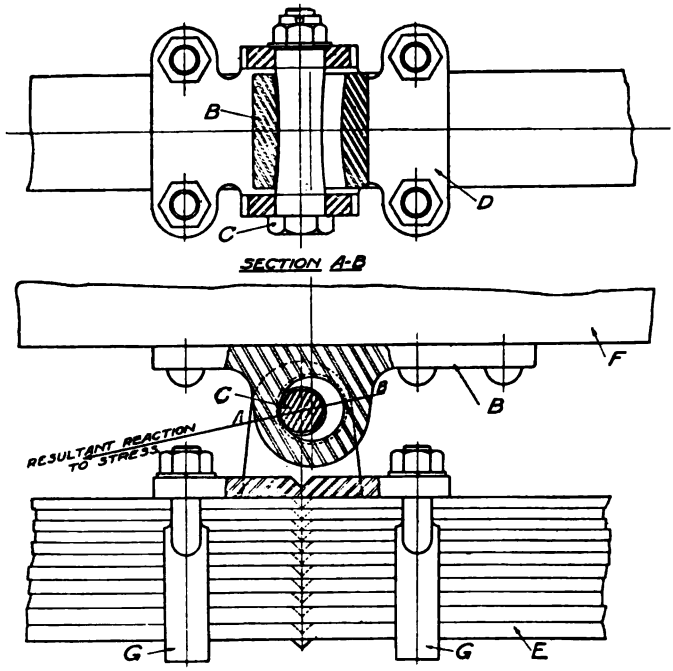

Fig. 3—Detail of the Rear Spring Pivot Bearing, illustrating the Rolling Contact Connection—The Tie-Rod Bearing at H and H′ (Fig. 1) are of the same type.

pin *C*, which in turn is secured to the rear spring by means of the spring plate *D* and clips *G*. A force diagram of the suspension will show a resultant bearing force in the plane *A B*, and the pivot pin will always ride in substantially this position. The action of the suspension is such that this force never reverses, thus permitting the use of a bearing of this type. The angular movement of the pivot pin never exceeds 15 degrees, and through this angle perfect rolling contact is secured. With rolling contact no lubrication is needed. One of the bugbears of spring suspensions is thus eliminated.

The tie-rod bearings at *H* and *H′* are of the same construction. Lubrication is eliminated from the entire system.

By making the frame bracket bell-mouthed and the pivot pin concave, another important constructional feature is obtained. Referring to Fig. 4 it will be noticed that the line of action of the suspension is on straight lines joining the spring center distance of the rear axle with that of the front axle. This, of course, makes the spring mounting at an oblique angle to the axles. With rigid pivot bearings lateral stresses and twisting of the springs would result when the axles play up and down. The rolling-contact type obviates this difficulty and

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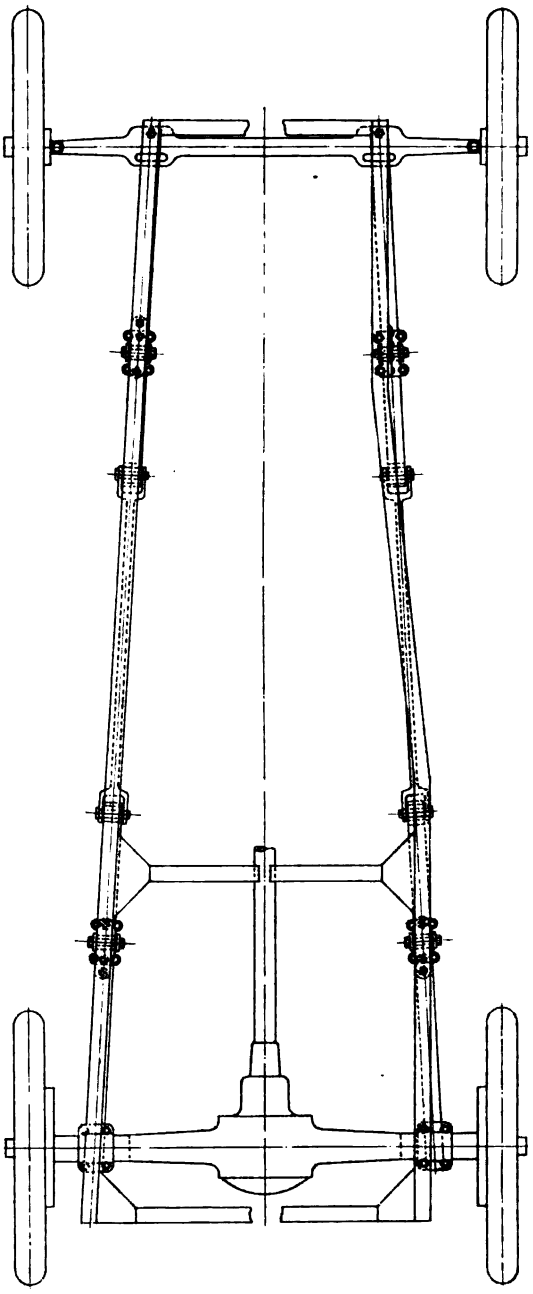

Fig. 4—Plan View of Fig. 1, Showing Straight Line Action of Suspension System, which joins the Front and Rear Spring Centers.

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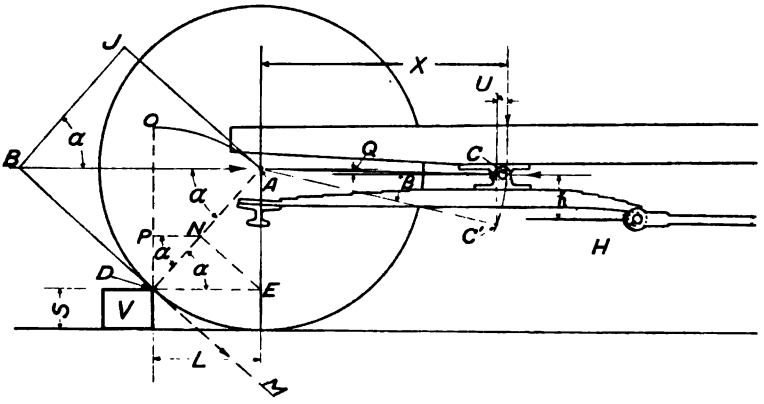

Fig. 5—Method of obtaining the Approximate Horizontal Component of the Shock Force in terms of Kinetic Energy of the Passenger Platform, showing how this Horizontal Component is Partially Absorbed in the "Give" in AC.

permits the application of the suspension to practically any type of frame, while the straight line action of the suspension introduces no thrust forces.

It will be noticed that in all of the analyses given, the vertical component of the road shock alone has been considered. It is very important, however, that the horizontal component of the shock force receive consideration, and since in a vehicle using the cantilever type of suspension the leaves of the front springs must resist the horizontal component of the road shock by stresses of compression, it will be well to consider the action of the front axle system from the standpoint of horizontal stress alone. With reference to Fig. 5, the front wheel is encountering a positive obstruction V, and in surmounting it the axle system must rise S inches. The time required will be that necessary for the wheel to travel through space L. For the sake of simplicity it will be granted that the center of gravity of the platform mass lies in the horizontal plane of the pivot point C. C, therefore, could be made to resist the kinetic energy of the mass of the entire platform. It should then be possible to measure the horizontal component of the energy lost in shock in terms of the total kinetic energy of the platform. When the obstruction V is encountered it is evident that the front wheel will tend to revolve about D as a center, and considering elasticity as lacking, the movement of A will be in the arc $A\,O$, having a radius $A\,D$ equal to the radius of the wheel.

It may be shown from Fig. 5 that $P\,N$ is the true horizontal component of the shock force. It may also be shown that if $K\,E$ is the kinetic energy of the platform at the moment of impact, the proportion of the energy destroyed by the horizontal resistance may be expressed by the equation $P\,N = \dfrac{K\,E\,(\cos\,\alpha)^4}{2}$.

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It will be noticed that the horizontal plane of the pivot C is below the plane of the wheel center A. The resistant to horizontal action is applied at A and the possible movement of the pivot C with respect to A will be in the arc $C\ C'$. When C reaches the position C' the horizontal projection X of $A\ C$ will be shortened by the distance U. The decrease in the length of $A\ C$ has a distinct shock-absorbing effect, as it may be considered identical to the action of a spring working through a space U.

Having considered the action of the compensating suspension system under different load and shock conditions, the advantages, both functional and structural, claimed for a system of this character, remain to be enumerated.

First, any shock force is divided and absorbed by the *whole* suspended mass, and the platform acceleration is thereby reduced. In comparison to this, in any conventional spring system, a shock force is absorbed by the mass of the platform supported by the axle receiving the shock. A simple relation between the two may be shown if it be considered that in both systems the mass of the platform is supported equally by both axles. Then if M is the mass resisting the shock in the conventional suspension, that is, the mass supported by the axle receiving the shock, a force F will produce an acceleration A, the value of which is expressed by $A = \frac{F}{M}$, while in the compensating system the force F is resisted by double the mass or $2\,M$, and the acceleration $A = \frac{F}{2\,M}$. The accelerations are, therefore, in the ratio of 2 : 1.

Second, road shocks of opposite sign occurring simultaneously are caused to counteract each other, thereby reducing the forces tending to accelerate the mass of the platform, and consequently reducing the platform acceleration and increasing the passenger comfort.

Third, vehicle springs in any suspension must be designed to carry a maximum load determined by the carrying-capacity of the vehicle. Passenger comfort increases as this maximum load is approached and decreases as the load diminishes. In the compensating suspension, as the passenger load is decreased and the spring action becomes rougher, the pivotal action of the mechanism increases, offsetting the stiffer spring action, passenger comfort being maintained to a marked degree.

Fourth, it is a well-known fact that leaf springs are comparatively slow in action and incapable of absorbing rapidly occurring shocks. This is evidenced by the increasing use of auxiliary springs, whose function is to absorb the minute vibrations due to small obstructions encountered at high speed. In the compensating suspension these vibrations are absorbed by rapid pivotal movements of the springs rather than by spring flexions. This action is very noticeable in

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traveling over brick pavements or roads of like character at high speeds.

Fifth, a study of the force diagram of the compensating suspension will show that the forces applied tend to hold the wheels against the roadway at all times. This results in better steering-action and improved traction, with a saving of tires on all the wheels. These constitute the more important functional advantages of the system.

Among the structural advantages may be mentioned, maximum wheelbase for any given frame length; low platform height with a consequent low center of gravity; minimum amount of unsprung weight on the axle system (since the thick portion of the springs is secured to the platform); a suspension system that is lubrication-less, that cannot rattle and takes up wear in the pivot bearings automatically.

The advantage of the absence of non-adjustable bushings in a suspension system cannot be over-estimated.

With springs attached rigidly to both the axle and the frame, side shocks are transmitted with almost their entire intensity from the wheels to the platform.

The reaction to the tension of the tie-rod places the frame in compression between the pivot brackets, and since the compression forces act below the lower web of the frame the result is a trussing effect to the frame, which opposes the bending action due to the loads upon the platform.

If the drive is taken through the rear springs the shock of sudden accelerations and retardations, due to starting and braking, is reduced by converting a part of the energy, longitudinal in direction, into work in a vertical plane by the pivotal action of the springs.

ADDITIONAL STANDARDS COMMITTEE APPOINTMENTS

At the March meeting of the Council the following additional appointments and assignments to the Standards Committee were made:

BALL AND ROLLER BEARINGS DIVISION

R. S. Lane

ELECTRICAL EQUIPMENT DIVISION

Frank Conrad

ELECTRIC VEHICLE DIVISION

T. H. Schoepf

MISCELLANEOUS DIVISION

W. A. Frederick
W. F. Herst
W. R. Strickland

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SECTIONS OF THE SOCIETY

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C. T. MYERS and W. N. OSBURN.....*Vice-Chairmen*
W. H. CONANT.....*Acting Secretary and Treasurer*

(Address) Kerr Bldg., Detroit, Mich.

Meets first Thursday each month at 8 p. m., in the Employers' Association Rooms, Stevens Building, Detroit, Mich.

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R. H. COMBS.....*Vice-Chairman*
CHAS. P. GRIMES.....*Secretary-Treasurer*

(Address) Wheeler & Schebler, Indianapolis, Ind.

Meets first Tuesday after first Wednesday each month at 8 p. m., at the Hoosier Motor Club in the Claypool Hotel, Indianapolis, Ind.

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(Address) 239 West 39th Street, New York City.

Meets third Thursday each month, except July and August, 8 p. m., at the Automobile Club of America, 247 West Fifty-fourth Street, New York City.

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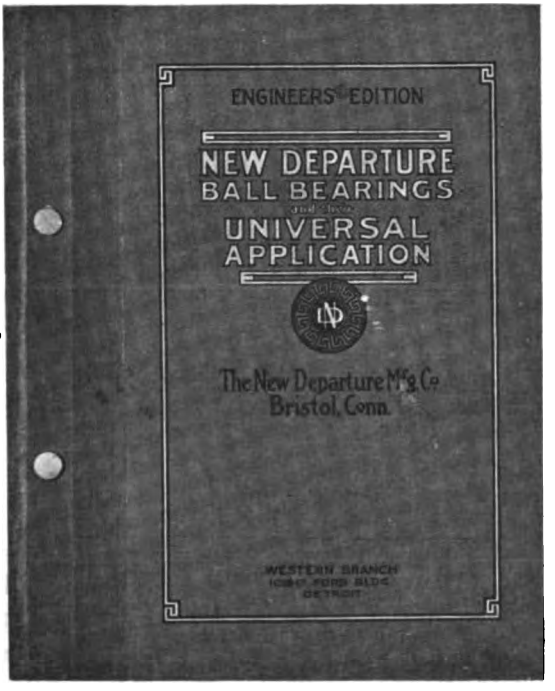
NEW DEPARTURE BALL BEARINGS

American Made for American Trade

We want every engineer in the United States to have this useful and valuable reference book.

The Fourth Edition, just off the press, is ready for mailing. If you have not received a copy, send for one today.



THE NEW DEPARTURE MFG. CO.
BRISTOL, CONN., U. S. A.
Western Branch, 1016-17 Ford Building, Detroit, Mich.

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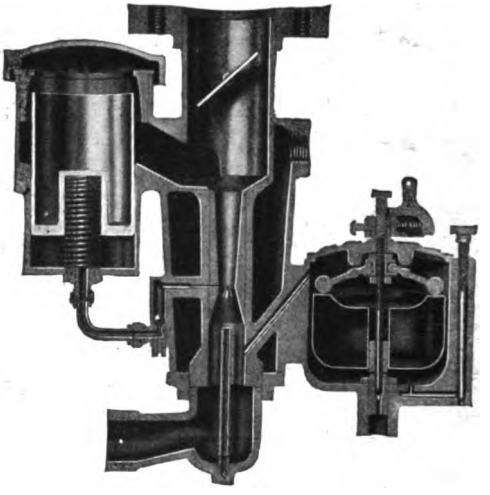
METERING

Browne Carbureter

The factor governing the fuel flow in the Browne is the velocity of the air entering the primary inlet; this, in combination with a venturi meter for control of the auxiliary air by the same factor, produces accurate results not heretofore believed possible.

The Browne will provide a mixture of constant air/gas composition best suited for a motor and maintain it through the speed range of the motor without regard to load, weather, climate or altitude changes, because its entire operation is governed by a natural law as positive as that of gravity.



Engineers and manufacturers who demand a higher standard of carbureter performance than obtainable with other equipment, will find in the Browne the qualities most desired.

Full information will be supplied, or tests arranged upon request to

Holt-Welles Company, Inc.

E. H. Stickels, President

1790 BROADWAY, NEW YORK

Detroit Branch: David Whitney Building
C. EVERETT MANNING, Technical Engineer

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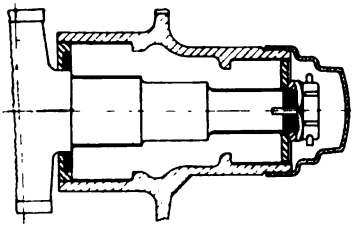
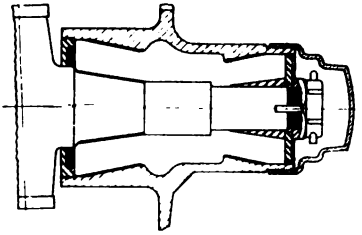
Simplicity and Economy in Mounting

THE GEORGE AUTOMATIC ROLLER BEARING

In mounting the GEORGE AUTOMATIC ROLLER BEARING great accuracy in machining is unnecessary. Both the inside and outside surfaces of the bearing being tapered, concentricity is automatically obtained while a variation in diameter of the housing or seat in mounting the bearing is compensated for by a slight lateral movement of the whole bearing.



A typical front hub for ball or roller bearings having parallel seats. The heavy lines indicate surfaces requiring expensive, close machining.



A typical front hub for GEORGE AUTOMATIC ROLLER BEARINGS. The tapered surfaces indicated by heavy lines require close machining for angularity only, exact diameter being unimportant.

The simplicity of machining a hub or a spindle for the installation of a GEORGE AUTOMATIC ROLLER BEARING will **increase production and eliminate entirely the losses occasioned through defective machining.**

Other features of the GEORGE AUTOMATIC ROLLER BEARING will be described in later issues of the S. A. E. Bulletin.

THE GEORGE AUTOMATIC ROLLER BEARING CO.
Walter H. Miller, President **Hamilton, Ohio**

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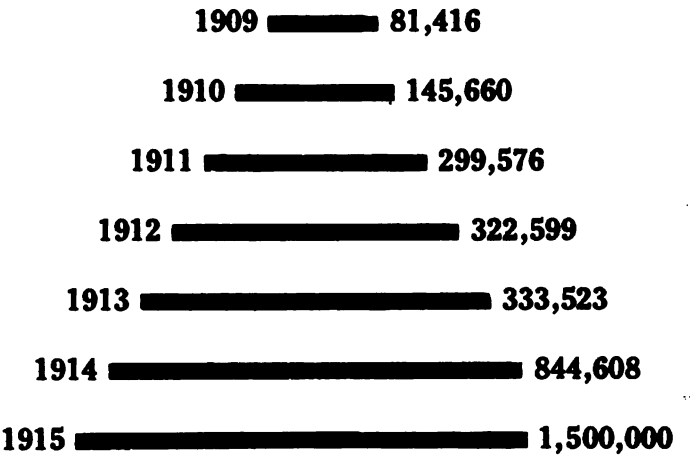
The

Reward of Merit

"Wheels"



A glance at the "Hayes" record affords a striking bit of proof of the promptness with which the motor world extends recognition to a product of proven worth.

With this year's orders far in excess of all previous years, the Hayes Wheel Company continues to lead the way as a thoroughly reliable source of supply for the best automobile wheels that can be made.

Hayes Wheel Company

Jackson, Michigan

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AIR TESTING MADE EASY

The operation of testing the air-pressure in tires having been found on occasion difficult and irksome by reason of the jamming together of the valve stem and dust cap, the firm of A. SCHRADER'S SON, Inc., have designed and placed on the market a new "Quick-Acting" dust cap which can be removed from the valve stem by a simple quarter turn.

The new SCHRADER "Quick Acting" dust cap eliminates the work of screwing the cap down the entire length of the valve stem to the felloe of the wheel. All that is necessary is to slip the cap over the valve and turn it one-quarter turn. This locks it securely to the valve stem. To unlock, simply give one-quarter turn in the opposite direction.

YOU CAN NOW TEST THE AIR PRESSURE IN YOUR TIRES WITHOUT EFFORT

The Schrader Universal Tire Pressure Gauge has been endorsed by Tire Manufacturers as the most reliable tire pressure gauge on the market.

Price, One Dollar

Manufactured by

A. SCHRADER'S SON, Inc.,

783-791 Atlantic Ave., Brooklyn, N. Y.

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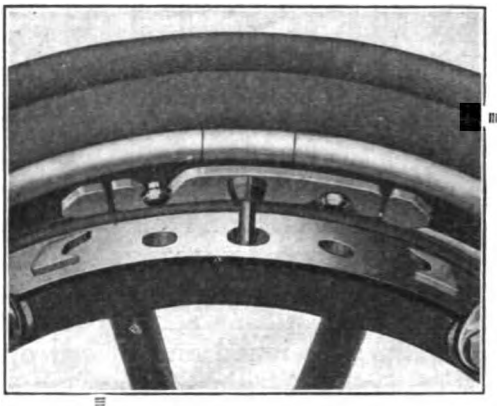

The Detroit Demountable Rim

The Rim that is Conclusively Mechanical

The arrow and "V"-block driving construction makes the Detroit Rim absolutely positive, and is the only demountable rim having this unique feature.

The cutout section of the Detroit Rim allows such freedom of operation in removing the tire that a pair of ordinary hands are the only tools—in extreme cases a small screw-driver is all that is necessary.

We claim for the Detroit Rim: strength, lightness, quality, economy and durability—a rim any novice can operate without the assistance of the "nearest garage."

We respectfully request the builders of motor cars to extend the opportunity of proving the worth of the above claims. Our prices are as interesting as our rim.

Jackson Rim Company

Jackson, Mich.

Exclusive Manufacturers of the Detroit Demountable Rim

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DELCO

ELECTRIC LIGHTING CRANKING IGNITION

No Car Can Be Any Better Than Its Electrical Equipment

Electricity is the nerve system of the modern motor car.

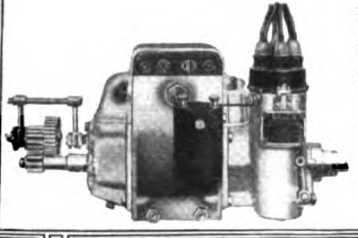
Engine Efficiency depends upon ignition.

Safety and Comfort and Convenience in driving depend largely upon the cranking and lighting equipment—That is why we say to you first and foremost—make sure that the car you buy is Delco equipped.

For four years the Delco System has led the way in the development of electrical equipment for gasoline cars.

Today the Delco organization has back of it the experience of over 200,000 Delco equipped cars in actual operation.

It has the largest, best equipped factory in the industry.



It has ample capital and a firm determination to maintain the leadership that has already caused the general acceptance of the Delco System as the world's standard.

The Dayton Engineering Laboratories Company
Dayton, Ohio

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APPLICATIONS FOR MEMBERSHIP

A list of current applications for membership is given below. The members are urged to send for the consideration of the Council any pertinent information with regard to those whose names are given which the Council should have prior to the election of any of the said applicants. It is requested that communications from the members in this connection should be sent promptly.

Breyer, Robt. S., Salesman, Don Lee, Los Angeles, Cal.
Carson, Clarence, Consulting Engineer, H. W. Johns-Manville Co. New York City.
Chapman, Lee A., Chief Engineer, Brewer Mfg. Co., Milwaukee, Wis.
Collins, B. W., Sales Manager, Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich.
Evans, Paul M., Engineer, Willard Storage Battery Co., Cleveland, Ohio.
Grund, Fletcher D., Assistant Production Manager, Milburn Wagon Co., Toledo, Ohio.
Hendrie, William, Secretary and Treasurer, Detroit Gear & Machine Co., Detroit, Mich.
Jones, Rufus B., Draftsman, Packard Motor Car Co., Detroit, Mich.
Liston, Joseph H., District Manager, Thermoid Rubber Co., Detroit, Mich.
Ridlon, John R., Repair Department Foreman, Locomobile Co. of America, Chicago, Ill.
Shobe, Vernon Ira, New York Representative, Zenith Carbureter Co., New York City.
Sloan, Sebastian N., Draftsman, Milburn Wagon Co., Toledo, Ohio.
Smith, Herbert A., Designer and Draftsman, J. I. Case Threshing Machine Co., Racine, Wis.
Thomas, Stanley R., Experimental Engineer, Hudson Motor Car Co., Detroit, Mich.
Tuttle, Walter I., Secretary and Treasurer, Frank Mossberg Co., Attleboro, Mass.
Twyman, B. W., General Manager, Inter-State Motor Co., Muncie, Ind.
Waite, Edwin E., Chief Engineer and Factory Manager, Standard Woven Fabric Co., So. Framingham, Mass.

(*Concluded on page* 10)

TESTING LABORATORY
....OF....
THE AUTOMOBILE CLUB OF AMERICA
54TH AND 55TH STS., WEST OF BROADWAY, NEW YORK CITY

The recognized authority for road and laboratory tests of Automobiles, Motors, Accessories, Fuels, Tires, Etc.

Open to any responsible person or concern for confidential development work or for official tests.

Descriptive bulletin and schedule of charges upon application.

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TORBENSEN

INTERNAL GEAR DRIVE AXLES

The axles which stand for the most advanced automobile engineering, with the separation of load-carrying and power-transmission carried out with mechanical perfection.

The load member is a carefully designed I-Beam, permitting ample strength in the minimum weight and bulk. The power is transmitted through a lay axle with spur-pinions engaging internal gear on the road wheels: a live shaft totally exempt from load strains.

This TORBENSEN Axle marks an epoch in sturdy truck construction, and our proposition for the truck manufacturer measures up to it. Write us.

Torbensen Gear & Axle Company

228 High Street, Newark, N. J.

MAKERS OF INTERNAL GEAR TRUCK AXLES EXCLUSIVELY

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(*Applications for Membership—Continued*)

Welton, Spencer, Vice-president and General Manager, Rutherford Rubber Co., Rutherford, N. J.
Whisler, Joseph C. Superintendent, Peru Auto Parts Mfg. Co., Peru, Ind.
Whitham, Glenn S., Superintendent of Electric Department, E. A. Brandes, Hastings, Neb.
Winther, Martin P., Truck Engineer, Thos. B. Jeffery Co., Kenosha, Wis.

APPLICATIONS APPROVED DURING MARCH

MEMBERS

Cleaver, Frank E., care of Peerless Motor Car Co., Cleveland, Ohio.
Ware, Walter C., care of Fay & Bowen Engine Co., Geneva, N. Y.

ASSOCIATES

Greer, Perry H., care of Greer-Robbins Co., Los Angeles, Cal.
Miley, L. J., 2009 Michigan Ave., Chicago, Ill.
Goddard, H. A., care of 5th Ave. & 34th St., New York City.
Seabury, Richard W., Box 571, Boonton, N. J.
Wood, W. D., 245 Underhill Rd., East Dulwich, London, S. E., England.

JUNIORS

Bender, Frank M., care of Lycoming Foundry & Machine Co., Williamsport, Pa.
Creager, F. L., 25 West 5th Street, Anderson, Ind.
Peavey, Harold F., 337 John Street, Bridgeport, Pa.
Smith George E., 221 N. 11th Street, Reading, Pa.

STUDENT ENROLLMENT

Houston, Harold S., 162 William Street, New Haven, Conn.

MEN AVAILABLE

0300. With twelve years' active experience, can fill intelligently and efficiently position as road or home service representative for manufacturer of gasoline trucks. Employed at present.

0301. A graduate of the Texknowlgic College (Russia) seeks a position as first-class draftsman or parts inspector with an automobile factory or automobile accessory concern in the Middle West.

(*Continued on page* 12)

Rajah
SPARK PLUGS
PRE-EMINENT FOR THE PAST 12 YEARS IN BOTH QUALITY AND EFFICIENCY
BOOKLET ON REQUEST
RAJAH AUTO-SUPPLY CO., Mfrs. BLOOMFIELD, N. J.

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Make and Size

Are the Two Greatest Tire Variables

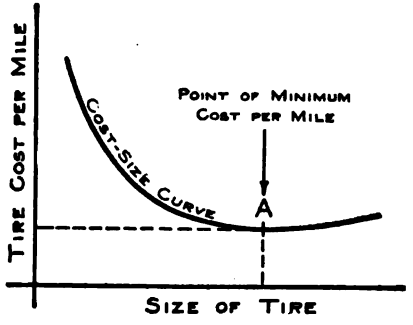
Make is at once fixed if you use Goodyear Fortified Tires—tires that are fortified in a thorough, scientific way against the troubles most commonly met.

To put into Goodyear Tires the best possible combination of materials and workmanship is naturally our first concern. But responsibility does not end there. We are interested not only to see you use Goodyear Tires, but the right kind and size of Goodyears as well.

Let Us Help You Locate the Point A

You have a car which carries a certain average load and which must comply with certain other conditions such as speed, comfort and the degree of protection desired for the car.

We have the data by which a tire can be selected to best meet those requirements. And this is **no small refinement.** Undersize tires commonly cost their owners more in a single year than is saved on the original investment.



GOODYEAR
AKRON, OHIO
Tires

It is of the utmost importance to the comfort and convenience of passengers and to the well-being of tires and car, to have tires that are right.

This advisory service is yours for the asking. Address Desk 106

The Goodyear Tire & Rubber Co., Akron, O.

Makers of Solid and Pneumatic Tires of All Types (2292)

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(Men Available—Continued)

0302. Electrical and mechanical engineer, 33 years of age, 12 years' experience, desires to make connection with some firm as electrical or mechanical engineer or superintendent. Also has selling experience.

0303. Managing and designing engineer of twelve years' experience in car and engine building, desires employment with automobile parts or automobile manufacturer, in the capacity of either sales promoter or production manager. Large acquaintance among dealers.

0304. Sales manager with fourteen years' experience in automobile accessory business, now employed by one of the largest manufacturers in business, is desirous of making a change for reasons which will be given in an interview and which may be confirmed by investigation. Thoroughly experienced in selling, sales systems, office management and credit work. Capable of employing and handling salesmen and getting the best results. Thorough acquaintance with big buyers. Would become financially interested in concern if services prove satisfactory. With present concern five years. Age 35 years.

0305. Superintendent of a high-grade automobile engine manufacturing company desires to make change. Good organizer, producing at low cost. Best reason for leaving present position. Best references.

(Concluded on page 14)

Our valve making plant is at your command. We are not the cheapest but our valves are not excelled by any. Every customer is a booster for "Lewis" Valves. Please send us your blue prints.

The Lewis Electric Welding & Mfg. Co.
4089 Detroit Avenue Toledo, Ohio

D. W. F. STEEL BALLS RENOLD DRIVING CHAINS

SUPERIOR AUTOMOBILE STEELS

NICKEL CHROME NICKEL CARBON ALLOY MAXIMUM HIGH SPEED

Send for New Steel Catalogue

SHELBY SEAMLESS STEEL TUBES

TUBULAR AUTO PARTS SPECIAL SHAPED TUBES

Send for Current Stock List

PETER A. FRASSE & CO., INC.
Buffalo 417-421 CANAL STREET, NEW YORK Philadelphia

TOOLS SUPPLIES, ETC.

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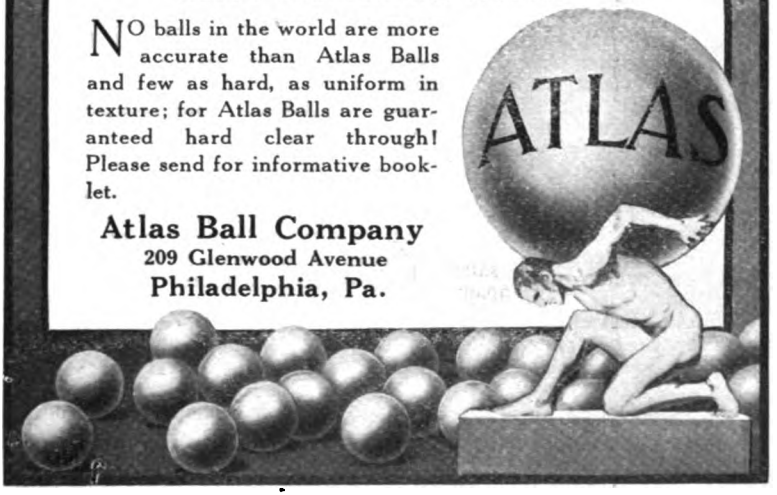
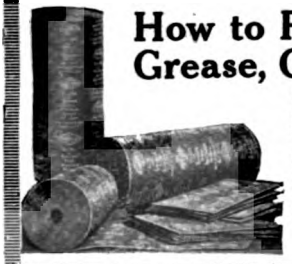
Accurate within 0.0001 Inch —these American Steel Balls

NO balls in the world are more accurate than Atlas Balls and few as hard, as uniform in texture; for Atlas Balls are guaranteed hard clear through! Please send for informative booklet.

Atlas Ball Company
209 Glenwood Avenue
Philadelphia, Pa.





How to Pack the Car Against Oil, Grease, Gasoline and Water Leaks

This little free booklet shows how to make *all* of the above connections absolutely leak-proof. It shows graphically *where* each kind of packing is best, and *where* to use and where *not* to use ENDURA, the packing made especially for this purpose. Write now for your copy of this booklet, chart and free ENDURA samples.

ENDURA MFG. CO.
6313 Eastwick Ave.
Philadelphia

ENDURA

"The part that sells the car"
(and truck)

Because it is known by car and truck builders and users that the science, art and practice of motor building offers nothing good that Buda fails to take advantage of.

THE BUDA COMPANY
Factory, Harvey, Ill. (Chicago Suburb)

Address FACTORY REPRESENTATIVES: BRANDENBURG & COMPANY
1108 S. Michigan Ave., Chicago
57th & Broadway, New York, N. Y
Dime Bank Building, Detroit

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(*Men Available—Continued*)

0306. Mechanical and electrical engineer. Capable and energetic, with excellent executive ability. Exceptionally good practical experience on both trucks and pleasure cars; in engineering, designing, purchasing, shop practice, construction and production. Especially competent on electric systems. Able to handle men and fully capable of assuming responsibility. Married. Age 33. Salary moderate.

0307. A1 production man and engineer. Technical graduate. Four years' shop experience, one year as machinist and tool designer. Five years' engineering experience. Designer of six pleasure models and one commercial.

0308. Engineer with fourteen years' experience. Has designed and built four- and six-cylinder and Knight-engined cars, electric transmission cars and electrics, also two-speed and worm drive axles. Detroit location preferred.

0309. Technical graduate twenty-eight years of age with four years' experience in design and construction of pleasure cars, desires position as technical assistant in service department, or position leading to that of sales engineer. Now employed in engineering department of company making all its own parts.

0310. Chief or assistant engineer. Experience covers eighteen years in manufacturing and engineering in sugar mills, steel mills and automobile plants.

0311. Man having college mechanical education and ten years' experience in several branches of the automobile trade, at present employed in supervising executive capacity, wishes to make a change and if possible secure a position in a department of some automobile firm which will bring him in touch with the purchaser. Wide acquaintance with influential men in all branches of the industry in New York, as well as the motoring public.

Automobile Castings

Gray Iron—Rough or Machined

You save the additional time, cost and annoyance of placing separate contracts when you make us responsible from blue print to finished product. We mould, grind, machine, assemble and inspect all under one roof. Visit our plant and be convinced or give us a trial order.

THE FERRO MACHINE & FOUNDRY CO
CLEVELAND, OHIO

FERRO

LETTERS FROM WISE ENGINEERS TO THEIR FRIENDS. No. 3

Larchmont, New York, March 1, 1915.

Emil Grossman Manufacturing Company,
Bush Terminal, Model Factory No. 20,
Brooklyn, New York

Gentlemen: It might interest you to know that these plugs (Red Head) have been used about 18,000 miles and have never been cleaned in the true sense of the term and have never been out of the motor except twice; once at about 6,000 miles and the second time at about 10,000 miles. * * *.

From an experience with a number of different makes of plugs bought in the open market for test in the high speed motors we are developing, we believe this is a pretty good showing. The six-cylinder piston-valve motor which we are developing seems rather hard on most plugs and our experimental work seems to point to satisfactory results from Red Heads.

Yours truly,

[Signed] LARCHMONT MANUFACTURING CO.,
Larchmont, New York.

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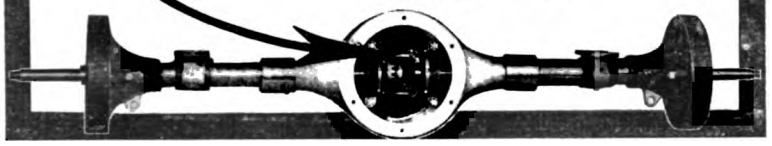
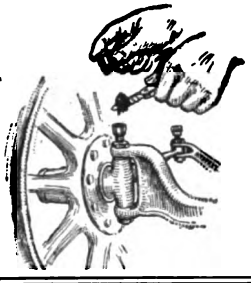
Sphere-Supported—this Rear Axle!

OF course, that's evident from the photograph—but consider the **inherent strength** of any metallic sphere! There are other points, also—stronger even than this—that account for the growing popularity of American Die & Tool Co. Rear Axles.
Standard, high quality, complete rear axles, transmissions and clutches, instantly adaptable to all cars from 1000 to 1400 lbs., and 1400 to 1800 lbs.—or special designs, incorporating your own ideas, for larger cars. May we send a catalog now?

AMERICAN DIE & TOOL CO.
READING, PA.



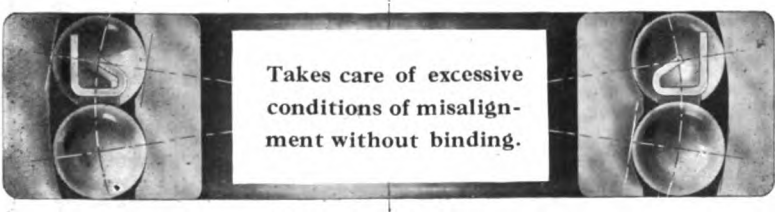


Try this in wheel spindles and cups

DIXON'S
GRAPHITE CUP GREASES

Made in Jersey City, N. J., by the
Joseph Dixon Crucible Company
Established 1827.

SKF *Self Aligning* BALL BEARING



SKF BALL BEARING CO.
50 CHURCH STREET NEW YORK CITY

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POSITIONS AVAILABLE

The following announcements are published for the information of members of the Society. No charge whatever is made for these announcements. Members who wish additional information will please address the office of the Society.

*209. Concern manufacturing small electrical motors in quantities wants draftsman or clerk experienced in the standardization of product, parts as well as tools. Must be familiar with drafting room organization and systematic recording of standards. State age, references and salary.

*Send written application to S. A. E. office to be forwarded to employer.

(*Continued on page* 18)

PRESSED STEEL
FRAMES
NONE TOO LARGE—NONE TOO SMALL
RUNNING BOARDS—STEP HANGERS
HEAVY STAMPINGS
SEND US YOUR BLUE PRINTS for Estimates
"QUALITY FIRST—SERVICE ALWAYS"
DETROIT PRESSED STEEL CO.
1804 MT. ELLIOTT AVE., DETROIT

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"NORMA"
BALL BEARINGS

You'll never get high-speed satisfaction from moderate-speed bearings. If your problem is one of high efficiency at high speeds under long service, there is ample precedent for your adoption of "NORMA" High Speed Ball Bearings as a feature of your standard construction. Others have done so—to great advantage.

THE NORMA COMPANY OF AMERICA

1790 BROADWAY NEW YORK

STAMPINGS

AUTOMOBILE PARTS

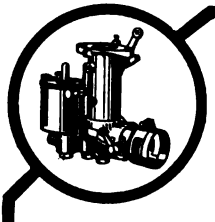
Put your automobile part problems up to our engineers. They specialize in producing stampings to better replace grey iron or aluminum castings—or die castings.

G.P.&F. Service

SHOWING NOW SINCE 81

places at your command a 15 acre plant modernly equipped—and 34 years' experience. Get estimate on Hoods, Gasoline Tanks, Mufflers, Pans, Housings, Metal Instrument Boards, Joint Cases, etc. We also do Japanning—Porcelain Enameling—job work of all kinds.

Geuder, Paeschke & Frey Co., 1365-1700 St. Paul Ave., Milwaukee, Wis.



FOR 8 CYLINDERS

The Zenith Duplex made in both vertical and horizontal types is the only American carburetor which can be made in double design giving uniform mixtures to each set of four cylinders with precision and in exact proportions.

ZENITH CARBURETOR CO.

DETROIT, U. S. A.

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(Positions Available—Continued)

212. Engineer with experience fitting him for position with a leading company to act as point of contact between the engineering department and the service, sales, advertising and publicity departments. One who can handle the mechanical instruction of salesmen, write instruction books and aid in experimental work.

213. Require the services of an experienced automobile truck draftsman with shop training. Salary depends upon the man.

MOTOR DU PONT FABRIKOID QUALITY
REG U S PAT OFF
IS GUARANTEED TO OUT-WEAR COATED SPLITS
It is replacing splits in the upholstery departments of several of America's largest auto manufacturers. Our top material is unsurpassed. Get a FREE SAMPLE and test it.
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The Electric Welding Products Company will hereafter be known as The Steel Products Company.

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Equipped with Spiral Bevel Gears and Bock Taper Roller Bearings

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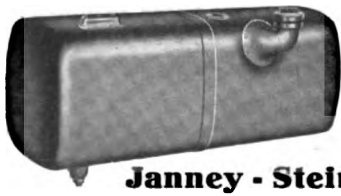

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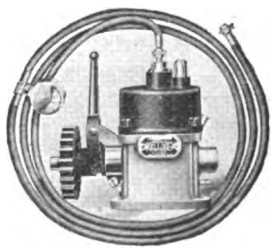

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in the newest and most modern steering gear factory in America.

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In three different races since the first of the year, cars have gone the full distance of over 300 miles *without a stop.*

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Austin	Dorris	Kline	Moreland	Singer
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This service requires Design, Material, and Workmanship of the highest grade.

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Unit Power Plant Transmissions to fit all standard motors up to 40 h. p.

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Samples of Texaco Motor Oil, taken at various times or bought in different parts of the country, show the same excellent characteristics.

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But we find it pays.

So will you.

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Department "S"

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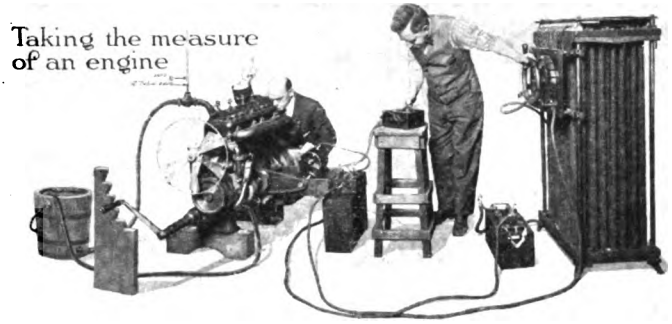

When you go to a custom tailor for a suit, he first takes your measure. From these specifications the garment is cut. Then the tailor makes the suit, according to the cut of the cloth. This done, you have a preliminary "try on." Very much the same operations are followed in making

THE WAGNER STARTER

The Starter that is built to order

First, the exact measure of the engine's cranking requirements, under all conditions, is scientifically taken. Specifications are then figured and working drawings are made. The starter is built from these. The result is a perfect fit—a starter exactly suited to the car for which it was made.

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The Wagner Company will be glad to send an experienced engineer to discuss with you the desirability of having a Wagner Starter designed and built for the car you are building.

Wagner Electric Manufacturing Co.

St. Louis

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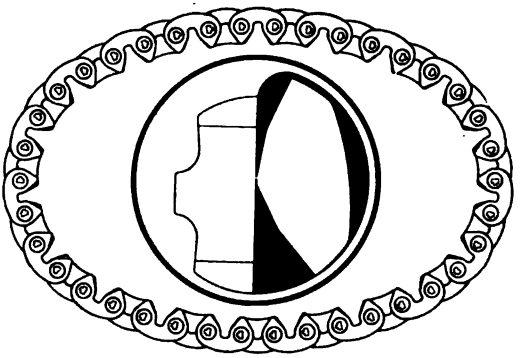
MORSE Silent Chains

for Automobile Engines



ADD this "Rocker-Joint" construction to the poorest materials now used in chain manufacture and you could have a better silent chain than one made of the best materials without this construction.

You can get this "Rocker-Joint" only in MORSE Silent Chains, and in addition we use the best obtainable materials.

The answer is—well, they are coming our way, which is sufficient proof of superiority.

Information cheerfully furnished.

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Largest exclusive manufacturers of silent chain transmission in the world

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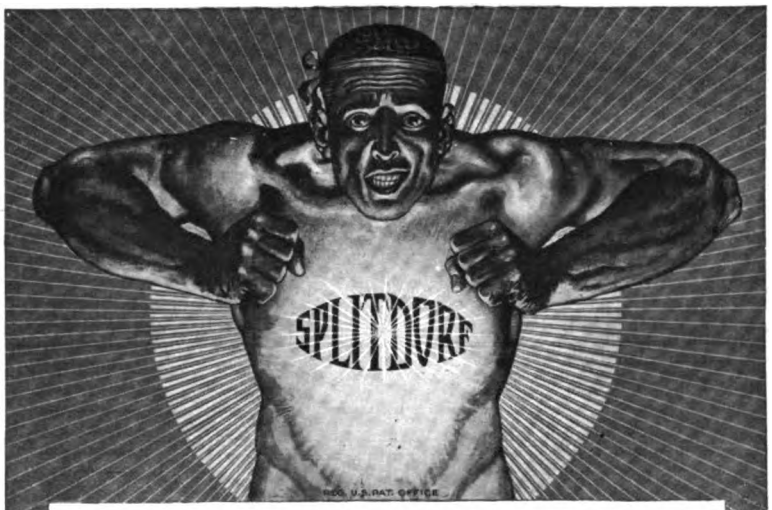

For easiest starting at lowest engine speeds—for highest gatling-like efficiency at top speeds—with no possible drain on battery—no lag at top speed—no nursing of the advance and retard—just vicious, consuming ideal ignition, performance is personified in the

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BY INVITATION MEMBER OF

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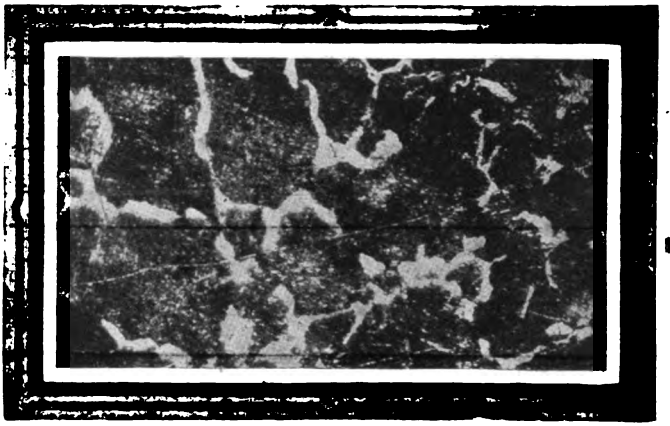

Micrograph of 90 carbon spring steel in the annealed state

Mistakes Only Waste Money.

OUR LABORATORY ELIMINATES SOME MISTAKES

The Perfection Spring Company

Cleveland, Ohio

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